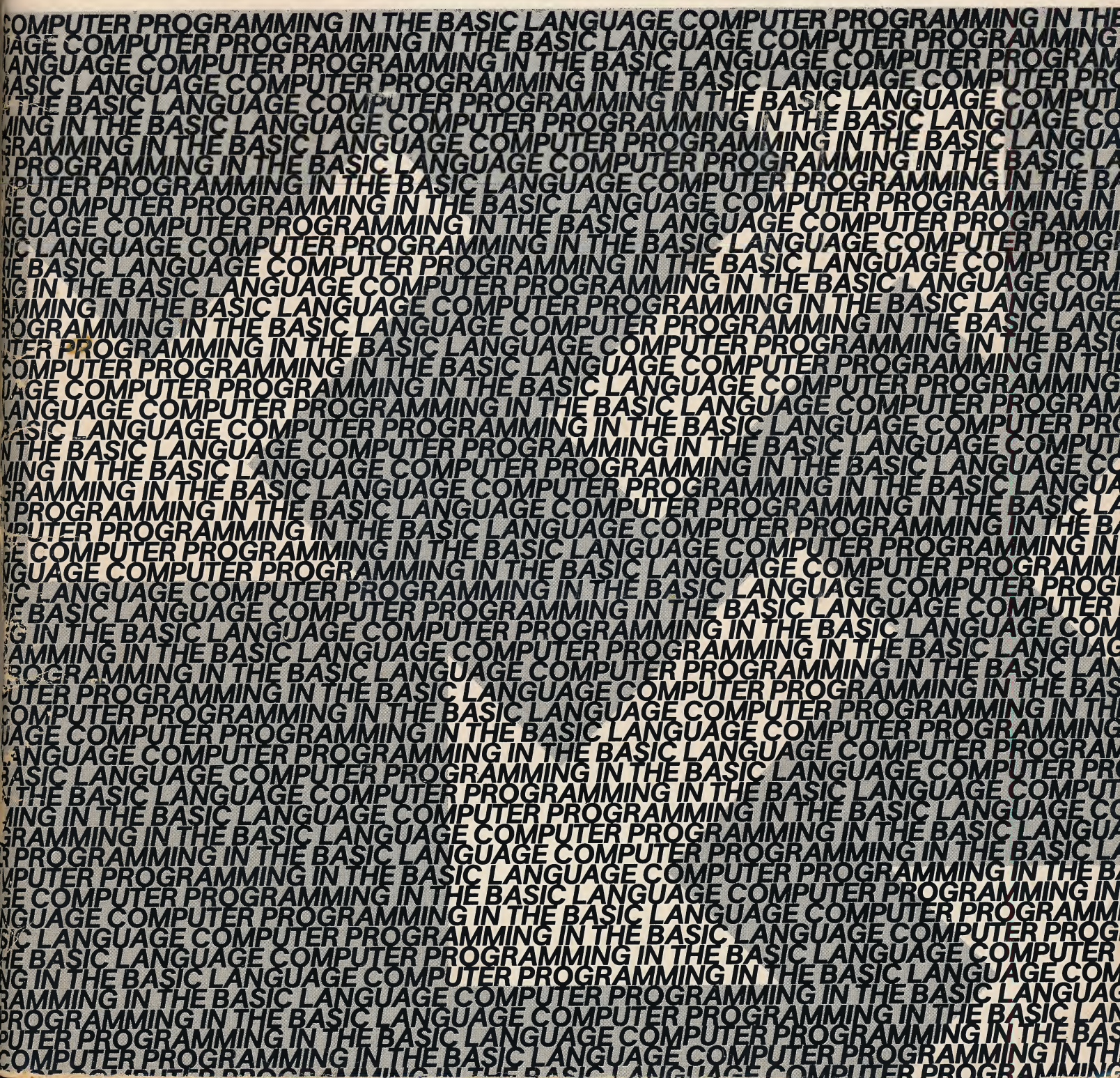
TEACHER'S GUIDE

COMPUTER PROGRAMMING IN THE BASIC LANGUAGE

Jacobs/French / Moulds/Schuchman



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Teacher's Guide

Computer Programming in the BASIC Language

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SECTION I

INTRODUCTORY NOTES

PURPOSE

The intent of the authors in writing this text is to bring computer programming within the grasp of the majority of students. The advancement in technology that has reduced the formerly enormous costs of operating a computer has made computers increasingly available in education, industry, and government. This availability has sparked in many people an interest in computers and in computer programming. The authors feel that it is not necessary to become a professional programmer to appreciate the computer in modern life. Completion of this introductory experience should be sufficient.

FORMAT

Computer Programming in the BASIC Language contains fourteen activity-oriented Topics that introduce BASIC, a widely used computer language. Each Topic contains expository sections which develop new material. The discovery technique is incorporated in many instances to demonstrate a need for the new material to be presented. The expository sections are accompanied by six types of sections of differing pedagogical purposes:

1. The Objectives are written in behavioral terms and appear at the beginning of each Topic. They enumerate the specific tasks that the student will be expected to have accomplished at the conclusion of the Topic.
2. The Introductory Activity (with Answers and Commentary) is a motivational activity prior to the presentation of new material. It reviews previously learned concepts, introduces new concepts, and injects, where appropriate, the requisite mathematical skills for proper understanding of the material. The Answers and Commentary serve to give the student immediate feedback.
3. The Exercises (with Answers and Commentary) serve as breaks in the expository sections. The student can use the Exercises to assess continually his or her progress. The Answers and Commentary give the correct answers, show possible areas where mistakes may occur, and review difficult points. There are two or more Exercises in every Topic. Occasionally a question or problem within the Exercises is used to introduce new material.
4. The Summary is a review of the important ideas and concepts in the Topic.
5. The Objective Activity (with Answers and Commentary) assesses the achievement of the objectives given at the beginning of the Topic. It is usually presented in two parts. The first part tests for vocabulary, programming techniques, and important concepts. The second part, designed to be done in a laboratory setting, tests the student's ability to apply the material learned. The Answers and Commentary give immediate reinforcement with references to text material.
6. The Problem Set provides additional exercises for the student.

Since no answers are given in the text, these problems may be used to evaluate the student's overall progress.

The above constitutes the material in the text exclusively devoted to programming. In addition, sections entitled Minitopics are interspersed throughout the book. They are meant to be interesting, motivational, and informative. In keeping with the introductory nature of the course, they impart basic information about computers: careers in the computer field, the historic development of computers, the capacities and modern uses of computers, and so on. Minitopics should stimulate discussion and offer a change of pace from the other sections of the book.

Two appendices conclude the text: Appendix A entitled "Basic Functions" and Appendix B entitled "Debugging."

TEACHER'S GUIDE

The Teacher's Guide is presented in four parts:

Section	I	-- "Introductory Notes"
Section	II	-- "Suggested Daily Lessons" with "Notes to the Teacher," which emphasize important points in each Topic
Section	III	-- "Answers to Problem Sets"
	Appendix	-- "Computer Use in Mathematics Classes"

STUDENTS

The previous mathematical experience necessary to complete the text is minimal. The student should be familiar with the arithmetic operations of addition, subtraction, multiplication, and division. The student should also understand exponentiation with integral exponents and operations with signed numbers. The absence of advanced mathematical prerequisites allows a vocational, general, or business (as well as an academic) secondary or college student to complete this course successfully. Nevertheless, the programming techniques taught in this text may be applied to mathematics at any level of sophistication. The student may be asked to apply his or her knowledge of programming to fields such as algebra, geometry, or trigonometry.

TEACHER

Although it is desirable for the instructor to have a background in computer programming, it is not necessary. The text material is written so that the teacher can learn simultaneously with the student. Classroom organization and suggested daily lessons are given in Section II of this guide as an aid for the teacher. The text may also be used in conjunction with courses other than specific computer programming courses, such as mathematics or science courses. The Appendix at the end of this guide suggests how this text may be used in various mathematics courses.

THE COMPUTER AND ITS LANGUAGE

Computers come in all sizes and price ranges and are manufactured by many companies throughout the world. All computers have the same three components: input/output devices, a central processing unit, and a memory. Input/output devices, such as the teletypewriter, punchcard reader, and printer, are units which allow the computer to receive and give out information. The central processing unit performs the arithmetic and decision-making operations at incredible speeds. The memory stores information that can be recalled during execution of a program.

Through the medium of the teletypewriter we are able to communicate with the computer. We, of course, must use a language that the computer "understands." The computer can only understand its "machine language," a series of binary numbers which instruct the computer to perform an operation. Machine languages differ from one computer to the next, but they are all fairly complicated. Even an apparently simple program can become quite complex when written in machine language. Fortunately, computer scientists have written long machine language programs, called compilers and interpreters, that translate programs written in simpler languages into machine language. Compilers and interpreters have made many computer languages available to the computer programmer.

Some common languages have been written to aid programmers in specific fields. ASSEMBLER is a language closely related to machine language that uses mnemonics instead of binary numbers to instruct the computer. FORTRAN is the language most popular with scientists and mathematicians because of a close resemblance to everyday mathematical language. The medium used to communicate with the computer in FORTRAN is the punchcard which is read by a card reader. ALGOL is a language which resembles FORTRAN, but is not widely used. BASIC, a second cousin to FORTRAN, is the most popular language used when teletypewriter communication with the computer is desired. COBOL is a language designed for business and other ordinary data processing purposes. There are many more languages, all of which have the common goal of easy communication with the computer.

BASIC

The language studied in this text is BASIC (Beginner's All-purpose Symbolic Instruction Code). BASIC was written as a time-sharing conversational language. A time-sharing system contains a central processing unit with one or more terminals or teletypewriters connected by telephone lines. These teletypewriters have the capability of operating simultaneously. A conversational language is one which gives you immediate feedback as you sit at the terminal. For example, if an incorrect instruction is typed, the BASIC compiler will detect the error and notify you immediately upon depressing the RETURN key.

There are many small and medium size computing systems manufactured today that have BASIC capability. These systems can be found in schools and other educational institutions, primarily for use by students.

The BASIC language presented in this text can be run on even the smallest system with BASIC capability. Of course, there is a larger BASIC vocabulary available on the larger systems.

There are many commercial concerns which rent computer time to the public through a teletypewriter connection. This method of computer rental is ideal for the BASIC language user. The cost of a connection is minimal and may be desirable for a school unable to purchase or rent an "on-site" system.

THE NEED FOR A COMPUTER

The text contains many examples of coding forms and computer input and output. The Exercises, Introductory Activities, and Objective Activities have accompanying Answers and Commentary. The student need only check his or her solution with the solution given. The motivated student can progress satisfactorily in this manner without an actual computer or terminal. Some computer center simulation would make instruction in this situation more effective.

SECTION II

SUGGESTED DAILY LESSONS

On the following pages "Suggested Daily Lessons" for the fourteen Topics in Computer Programming in the BASIC Language are given to aid the instructor in planning a semester course using this text. Each of the Topics is broken down into two types of class structures: "Instructional Periods" and "Laboratory Periods."

The Instructional Period is a structured lesson given in a classroom environment; it requires four types of activities.

1. The "Opening Activity" is a motivational drill that introduces new material or reviews previously learned material. The problems listed are taken from the Introductory Activity, Exercises, or Problem Sets and should not take more than five to eight minutes to complete.
2. The "Development-Discovery Activity" introduces new material to the class. Page numbers indicate the amount of material to be covered.
3. The "Reinforcement Activity" consists of selected problems from the Exercises which reinforce newly learned material.
4. The "Summary" reviews the new material. The page number shown is that of a Summary page or a page from which a summary of the day's lesson may be extracted.

A suggested "Homework Assignment" is also given. The assignments are spiraled: problems from previous Problem Sets are assigned in succeeding Topics, and eventually all problems are assigned. The homework problems enclosed in parentheses are optional problems which may be assigned according to the maturity level of the student.

The Laboratory Period is an unstructured period and should be used much as a laboratory period is used in chemistry or physics. Students

are given one, two, or more days to complete their experiment, which is the Objective Activity. No homework assignment is given, for the student may need nonschool time to type his or her program and achieve the desired results. These periods provide a good opportunity to divide the class into groups with each group submitting the Objective Activity. A separate room containing one or more teletypewriters can become the computer laboratory.

The following assignments and activities have been suggested with the general student in mind. If they are to be used, adjustments to fit the nature of the class or individual using the text will have to be made.

COURSE OUTLINE

Topic	Instructional Periods - Lessons -	Laboratory Periods - Lessons -
1	1, 2, 3	4
2	5, 6, 7, 8	9, 10
3	11, 12, 13	14, 15
4	16, 17, 18	19, 20
5	21, 22, 23, 24	25, 26
6	27, 28, 29	30, 31
7	32, 33, 34	35, 36
8	37, 38, 39, 40	41, 42
9	43, 44, 45, 46	47, 48
10	49, 50, 51	52, 53
11	54, 55, 56	57, 58
12	59, 60, 61	62, 63
13	64, 65, 66	67, 68
14	69, 70, 71	72, 73

TOPIC 1 PEOPLE AND COMPUTERS

Instructional Periods 3 Laboratory Periods 1

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
1	Intro. Act. p. 1	 pp.4 - 8	p. 9 Exer. One: 1,2	p. 8	Study pp. 1 - 8 Solve p32: 1, 2, 3a, 4
2	p. 9 Exer. One: 3	pp. 10 - 12	p. 13 Exer. Two: 1	p. 12	Study pp. 10 - 12 Solve p32: 3b, 5, 6 8 p33: 9a
3	p. 13 Exer. Two: 2	pp. 14 - 22	pp. 22 - 23 Exer. Three	p. 26	Study pp. 14 - 22 Solve p32: 7 p33: 9b, c p34: 10, 11 p35: 15
4	Laboratory Period ... Pages 26-28				

DESCRIPTION

The BASIC instructions for solving an arithmetic program are written on a coding form. These program instructions are typed on a teletypewriter (computer terminal), read, and then executed by the computer.

NOTES TO THE TEACHER

Page 2. WARNING! Class time may be used needlessly discussing the meaning of THINK. Get on with the main objective of the Topic.

Page 6. The computer program instructions shown are written in a computer language called BASIC.

Page 7. The user of an off-site computer is connected to the computer by means of telephone lines. The user actually dials a telephone number, listens for the computer's dial tone indicating that the computer has answered, and submits an identification code to the computer which identifies a proper user.

Page 8. REMARK statements, used to write messages, can be placed anywhere between SCRATCH and END in a BASIC program.

Page 10. The processing cycle is basically the same for all computing systems: input, computer, output. The equipment used in other systems, however, is different.

Page 11. The BASIC coding form shown was designed for use in this text. Different computer languages use different coding forms.

Page 13. If coding forms are not available, use 1/4 inch graph paper.

Page 16. Misspelling must not occur in the first three letters of BASIC key words.

Page 19. See Appendix A for additional information about errors.

Page 21. Suggest that students use line numbers which are multiples of 5 or 10. There is an upper limit for the value of line numbers. Check your system's programming manual.

Note: PRINT is used liberally throughout the text to refer to either hard copy output or video display.

TOPIC 2 ELEMENTS OF BASIC

Instructional Periods 4 Laboratory Periods 1

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
5	Intro. Act. p. 37	pp. 38 - 41	p. 41 Exer. One: 1, 2, 3	p. 40	Study pp. 37 - 41 Solve p64: 1a - 1f p33: 9d p34: 12
6	p. 41 Exer. One: 4, 5	pp. 42 - 44	p. 45 Exer. Two: 1, 2	p. 44	Study pp. 42 - 44 Solve p64: 1g-j, 2a p65: 4, 5a, d p34: 9e p35: 13
7	p. 45 Exer. Two: 3, 4	pp. 46 - 49	p. 51 Exer. Three: 1, 2a, b, 3a	pp. 47-48	Study pp. 46 - 49 Solve p64: 3a, b, c p34: 9f p35: 14
8	p. 51 Exer. Three: 2c, d, 3b	pp. 52-54	p. 54 Exer. Four	p. 54	Study pp. 52 - 54 Solve p65: 5b, f, i p66: 6a p35: 17
9	Laboratory Period ... Pages 58 - 61				
10	Laboratory Period ... Pages 58 - 61				

DESCRIPTION

The fundamental BASIC instruction is defined and the BASIC arithmetic operations are performed in a prescribed order called the Hierarchy of Operations.

NOTES TO THE TEACHER

Page 38. The word "formula" best describes the equality which follows the word "LET." When a computer executes the statement, X = X + 1, it calculates the value of X + 1 using whatever value X had before this statement and assigns this new sum, X + 1, to X erasing the old value of X. See page 44 for an example of a sequence of instructions demonstrating this procedure.

Page 40. A common error in programming is to use variables in the right-hand side of a formula which have not been assigned a value previously. These variables are called undefined variables in a program. Emphasize that variables used in the right-hand side of the formula must have values previously assigned to them in the program.

Page 43. Exponentiation in some BASIC systems is a double asterisk, **.

Page 44. It is important that students understand what happens when the computer executes the sequence of instructions. Again emphasize that the value on the right-hand side of an arithmetic statement is assigned to the variable on the left-hand side. This is an important point and should be clearly understood. It may be necessary to analyze several times the computer execution of the sequence of instructions.

Page 47. The ranks given the arithmetic operations indicate an order of operation which is the same order under which all mathematics operates.

Page 48. Parentheses alter the order of operations in BASIC in the same manner that they alter the order of operations in all of mathematics.

Page 49. With two successive exponentiations, always use parentheses to avoid confusion and to clarify the meaning of the arithmetic expression or statement.

TOPIC 3 DATA IN AND OUT

Instructional Periods 3 Laboratory Periods 2

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
11	Intro. Act. p. 67	pp. 68 - 70	pp. 70 - 71 Exer. One: 1, 2, 3a, b	p. 70	Study pp. 67 - 70 Solve p97: 1a, d, 4a p98: 10a p64: 2b p35: (16)
12	p. 71 Exer. One: 3c	pp. 73 - 77	pp. 77 - 79 Exer. Two: 1, 2	p. 77	Study pp. 73 - 77 Solve p97: 1b, c, 2a, b, 3a p99: 16 p64: 3e, f, g
13	p. 79 Exer. Two: 3	pp. 80 - 84	pp. 84 - 85 Exer. Three	pp. 87-88	Study pp. 80 - 84 Solve p97: 3b p98: 6a, b p99: 12a, b, (14), 17 p65: 5e p66: 6b
14	Laboratory Period ... Pages 86 - 87, 89 - 92				
15	Laboratory Period ... Pages 89 - 92				

DESCRIPTION

The structures of INPUT, READ, PRINT, and DATA statements are analyzed and methods of inputting and outputting are explained.

NOTES TO THE TEACHER

Page 67. A data entry statement is liberally defined. Some may disagree with this definition.

Page 69. All systems may not signal data entry with a question mark. Consult a manual for the system you are using. Best of all, experiment.

Page 70. The data entered will be assigned to the variables of an INPUT statement in the same order as the data listed in the INPUT statement.

Page 73. The computer assigns values to the variables in the order listed in the READ and DATA statements.

Page 75. Sufficient data must be present in DATA statements for program execution.

Page 81. Commas and semicolons may output data differently on your system. Consult the manual for your system which describes the print fields using commas and semicolons.

Page 82. Material to be outputted in printed form may be placed anywhere in a PRINT statement.

Page 84. Remind students that the statements 20 PRINT and 30 PRINT are valid BASIC instructions. A blank after PRINT causes the computer to skip a line.

Page 86. Students may recognize 1.23456×10^6 as scientific notation. Floating point notation can be explained in terms of scientific notation if the students understand scientific notation.

Page 86. The computer computes internally in floating-point notation regardless of how the numbers were inputted. It outputs numerical data in either standard or floating point notation. It is only necessary for the programmer to convert floating-point output to standard notation.

TOPIC 4 FLOW CHARTS AND PROGRAM BRANCHING

Instructional Periods 3 Laboratory Periods 2

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
16	Intro. Act. p. 101	pp. 102 - 105	p. 106 Exer. One: 1, 2	pp. 102-103	Study pp. 102 - 105 Solve p132: 1 p133: 3a, 4 p100: 18 p99: 12c, (12d) p97: 2c, 5a-c p64: 3h
17	p. 106 Exer. One: 3	pp. 108 - 114	p. 115 Exer. Two: 1, 2a, b, 3a	pp. 112-114	Study pp. 108 - 114 Solve p133: 2, 5b, 6a p135: 11, (13), 15 p100: 19 p99: (13) p98: 6d, (7a), 8 p97: 4c p64: 6i

18	p. 115 Exer. Two: 2c, d, 3b	pp. 116 - 122	p. 122 Exer. Three	pp. 125-126	Study pp. 116 - 122 Solve p134: 7, 8a-d, 9a, c, d, 10a p133: 5e, f p136: 16, 17, (18) p100: (21) p98: 7b, (7c), 9, 10b p97: 5d-f p65: 5g
19	Laboratory Period ... Pages 126 - 128				
20	Laboratory Period ... Pages 126 - 128				

DESCRIPTION

The student will be introduced to flow charting as an aid in solving problems. In addition, the student will be introduced to branching as a means of altering the sequence of steps in a program.

NOTES TO THE TEACHER

Page 102. The number of flow chart symbols used in this text has been kept to four in order to keep the mechanics of flow charting as simple as possible. The use of very few symbols, while not a standard treatment of flow charting, will emphasize the secondary and supportive role of flow charting in problem solving techniques.

Page 108. While a flow chart is not actually a computer program, it is a very short step away from being one. Thus, our flow chart statements will look very much like their corresponding BASIC statements in both structure and syntax.

Page 109. The use of flow charts has been delayed until this Topic because, until this point, there has been no mention of branching. Without branching, a flow chart is nothing more than a program whose steps have been enclosed in rectangles. Under these circumstances, a flow chart would add nothing to the solution of a problem.

Page 109. The IF-THEN statement permits a sequence of program statements to be executed out of sequence. If the sentence following the word IF is true, the computer is directed to some point of the program identified by the designated number. It executes the statement bearing this number and continues executing the following statements in sequence unless it encounters another branching statement.

Page 109. The student should have some familiarity with the relations 'greater than' or 'less than' and their corresponding symbols. Only a very elementary knowledge is necessary and could be included as part of the course.

Page 110. In many BASIC systems, a statement such as 20 IF A = B THEN 20 would be accepted. At execution time, if the sentence A = B is true, the computer will be caught in a loop from which it cannot escape. Such a loop is called an infinite loop. The programmer might not be aware of the difficulty until he or she realizes that an unusually long time has passed without a computer response. It is essential that the programmer intervene by depressing the BREAK key followed by the RETURN key. No effort should be made to re-enter the program until the cause of the infinite loop has been diagnosed and corrected.

Page 117. The GO TO statement, as used in the example of figure 4.29 on this page, is simply an alternate way of doing the problem. It serves to illustrate one use of the GO TO statement but offers no real advantage over the program of figure 4.27. The real advantages of the GO TO statement will become apparent later in this Topic and in those which follow.

Page 118. Some programmers use different kinds of symbols to represent different types of computer processes. For example, a parallelogram is sometimes used for data input, and a trapezoid for data output. It is the belief of the authors of this text that all processing can best be represented by a rectangle.

Page 119. The number -99999 has been arbitrarily chosen as a trailer number simply because it is unlikely to be used as data. Any number not expected to appear as data may be used.

Page 121. As stated in the discussion concerning DATA statements, only one trailer number is actually used as such for terminating the program. The second of these numbers is a dummy number. That is, it is used to satisfy the 30 READ B, H statement, but the last value for H is never used.

TOPIC 5 FOR...NEXT LOOPS

Instructional Periods 4 Laboratory Periods 2

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
21	Intro. Act. p. 137	pp. 138 - 141	p. 141 Exer. One: 1a-f, 2a, b	pp. 140-141	Study pp. 137 - 141 Solve p166: 1a, 2 p167: 8a p64: 3d p65: 5c p97: 4b, 15 p133: 3b p134: 8e, 9b

22	p. 141 Exer. One: 3	pp. 142 - 146	pp. 146 - 147 Exer. Two: 1a, b, 2a, c, 3a, b	p. 146	Study pp. 142 - 147 Solve p166: 1b, 4, 6 p167: 9a, 11a, c p168: 13a p66: 6c p98: 7d p133: 5c
23	pp. 144 - 147 Exer. Two: 2b, d, 3c	pp. 148 - 151	pp. 151 - 152 Exer. Three: 1, 2, 4, 5b	pp. 150- 151	Study pp. 148 - 151 Solve p168: 12a, b, 14a, 15 p167: 8b, 11b p65: 5h p99: 11a p134: 14
24	p. 152 Exer. Three: 3, 5a	pp. 154 - 157	p. 157 Exer. Four: 1a, b, 2a, c	pp. 158- 159	Study pp. 154 - 157 Solve p157: 2b, d p168: 12b p169: 14b, 18 p135: 12 p97: 2d p133: 5d p100: 20
25	Laboratory Period ... Pages 159 - 162				
26	Laboratory Period ... Pages 159 - 162				

DESCRIPTION

The student will be introduced to the computer's counting process. This and its shortcut equivalent, the FOR...NEXT statements, form the basis of much of the computer's repetitive processes.

NOTES TO THE TEACHER

Page 140-141. The components of a loop will be used in very many programs and should be committed to memory.

Page 142-143. Using the FOR...NEXT statements as opposed to the counting loop does not save the computer either time or space. In fact, the FOR...NEXT statements cause the computer to set up virtually the same steps it does for the counting loop. The savings are all the programmer's.

Page 144. The FOR and NEXT statements should be considered as a unit. Since we think of the FOR statement as setting the initial values, it is executed only once, at the beginning of the loop. The NEXT statement we think of as being executed every time the loop is repeated.

Page 146. Note that in example 3 the statement 30 FOR J=1 TO 16 STEP I indicates that the increment I is a variable. This

would be perfectly valid if the statement 40 LET I = 4 were not present.

Page 148. The FOR...NEXT flow chart adopted in this text is not one which is universally accepted. It is presented here because of its simplicity and similarity in appearance to the corresponding BASIC statements.

Page 154-155. Throughout this and following topics the quantity following the word TO in a FOR statement is called a 'final' value. It is not necessarily true that the index will assume this as its actual final value. The loop will be terminated when the value of the index first reaches or exceeds this number. For example, in the FOR statement 10 FOR I=1 TO 8 STEP 3, the index I takes on the values 1, 4, 7, 10. It will terminate on reaching the value 10, the first value greater than the listed final value 8.

TOPIC 6 ACCUMULATING AND TABLE HEADINGS

Instructional Periods 3 Laboratory Periods 2

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
27	Intro. Act. p. 171	pp. 172 - 175	p. 175 Exer. One: 1a, 2, 4	pp. 172-173	Study pp. 172 - 175 Solve p199: 4a p200: 6a p201: 9a p98: 6c p133: 5d p166: 5 p169: 17
28	p. 175 Exer. One: 1b, 3	pp. 177 - 179	p. 180 Exer. Two: 1a, c, 3	pp. 178-179	Study pp. 177 - 179 Solve p199: 4b p200: 5a, b, 6b p201: 10 p133: 6b p167: 8c, 11d p168: 13b
29	p. 180 Exer. Two: 1b, 2	pp. 182 - 189	p. 190 Exer. Three: 1a, b, 2a	pp. 193-194	Study pp. 182 - 189 Solve p190: 1c, d, 2b p199: 1a, 2a, 3a p200: 6d p201: 11 p167: 8d p168: 12c

30	Laboratory Period ... Pages 194 - 196
31	Laboratory Period ... Pages 194 - 196

DESCRIPTION

In this topic, the student will be introduced to the method by which the computer accumulates sums and products. In addition, this topic will show how the results of any repetitive process can be displayed in a table form with appropriate headings and labels.

NOTES TO THE TEACHER

Page 172. The expression S = S + A, repeated several times, reflects the method most people use to add a column of digits. At each step in the process, a new addend, A, is added to the partial sum, S. It should be noted that the READ statement is repeated 4 times. This means that 4 data numbers must be supplied, one for each time the READ statement is executed.

Page 187. Attractive and functional output can be maddeningly difficult to produce. Usually the programmer can block out the desired output on coding forms or graph paper counting characters and blank spaces to establish the format. Next, the judicious use of quote fields and/or TAB expressions are used to approximate this output. Often, it is necessary to test-run the program several times just to get labels and headings properly aligned.

TOPIC 7 BASIC FUNCTIONS

Instructional Periods 3 Laboratory Periods 2

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
32	Intro. Act. p. 203	pp. 204 - 206	pp. 206 - 207 Exer. One: 1, 2a, c, e, 3a, 4	p. 218	Study pp. 204 - 206 Solve p223: 1f, 2a, b, 4a, d, 5a, b p224: 9a, b, 10 p225: 12 p134: 10b p199: 1b, c, 3b p201: 8
33	p. 207 Exer. One: 2b, d, f, 3b	pp. 209 - 213	p. 213 Exer. Two: 1, 3, 5	p. 218	Study pp. 209 - 213 Solve p223: 1a, c, 2c, 3a, e, 4b, c, 5c, d p224: 6a, b, 7a, 8a, c p225: 13 p167: 11d p199: 2c p201: 7a, 9b
34	p. 213 Exer. Two: 2,4	pp. 214 - 216	p. 217 Exer. Three: 1, 2, 3	p. 218	Study pp. 214 - 216 Solve p223: 1b, 2d, e, f, 3a, d p224: 6c, d, 7b, c, d, 8b, d, f, 9d p225: (15, 16, 18) p199: 1d, 2d p200: 6e p201: 12
35	Laboratory Period ... Pages 219 - 220				
36	Laboratory Period ... Pages 219 - 220				

DESCRIPTION

In this topic, the student will be introduced to a set of already-written programs called Functions which will effect a great economy of the programmer's time and effort.

NOTES TO THE TEACHER

Page 204. While there is a great variety of BASIC functions, all have a format similar to that shown in this example. A function, during execution, will initiate a sequence of steps and produce a single number.

Page 206. The argument of the SQR function must, of course, be non-negative. In many systems, however, a negative argument will automatically be converted to its absolute value and the square root then extracted.

Page 210-211. The RND function does not produce a pure random number. It will, in fact, produce a sequence of numbers which would eventually repeat. Its sequence, however, is so extremely long, more than a million numbers, that for our purposes the numbers can indeed be considered random.

Page 214. In the SIN function, as in all trigonometric functions, the argument must be expressed in, or converted to, radian angular measurement. The conversion is very simple and is explained on page 215.

Page 218. A complete list of BASIC functions can be obtained from your computing center. These may vary, depending on the system used. It is important to note that the BASIC inverse trigonometric functions will always return the result in radians.

TOPIC 8 SUBSCRIPTING

Instructional Periods 4 Laboratory Periods 2

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
37	Intro. Act. p. 227	pp. 228 - 233	p. 230 Exer. One: 1, 2 p. 233 Exer. Two: 1	p. 229 p. 232	Study pp. 228 - 235 Solve p254: 1, 2, 3a, b p255: 6a, c, e, 7a, 8a p166: 3, 7 p169: 16
38	p. 233 Exer. Two: 1	pp. 236 - 240	p. 240 Exer. Three: 1, 2	pp. 238-239	Study pp. 236 - 240 Solve p254: 4, 5a p255: 6b, d, 7b, e, 9a, b p167: 10 p258: 17
39	p. 240 Exer. Three: 4	pp. 243 - 246	p. 246 - 247 Exer. Four: 1, 2	pp. 243-244	Study pp. 243 - 246 Solve p255: 8b p256: 10a, b, c p257: 12, 13 p258: 14, 18 p199: 2b
40	p. 254: 3c, 5b	pp. 248 - 249	p. 247 Exer. Four: 3 p. 240 Exer. Three: 3	p. 249	Study pp. 248 - 249 Solve p254: 5c p255: 7c p256: 9d, 10d p259: 19 p199: 4c
41	Laboratory Period ... Pages 249 - 254				
42	Laboratory Period ... Pages 249 - 254				

DESCRIPTION

This Topic will introduce the student to subscripted variables as a method of storing and manipulating an array of numbers.

NOTES TO THE TEACHER

Page 229. The process for creating a list or an array of variables used in BASIC closely parallels the mathematical technique of subscripting. Hence the name subscripted variables. It is expected that relatively few students using this text will be familiar with subscripted variables. Unless you are teaching a class in algebra which is familiar with subscripted variables, the discussion should be limited to subscripting only as it applies to BASIC programming.

Page 232. The DIM statement serves two purposes: first, it announces that a certain variable will be used only as a subscripted variable, i.e. with parentheses enclosing a positive integer; second, it enables the computer to allocate sufficient storage to accommodate the expected maximum number of data entries.

Page 236. The ability to use the variable as a subscript gives the computer tremendous versatility. This is the technique by which an actual program instruction can be changed while the program is being executed. For example, the instruction 10 READ A(2) can be changed to 10 READ A(3). This technique, called <u>program modification</u>, along with the ability to make decisions, distinguishes the digital computer from any other calculator.

Page 243. The program on this page shows how numbers stored in a list can be manipulated. In this case, the manipulating accumulates the sum. Such manipulation is usually under the control of a FOR-NEXT loop.

TOPIC 9 NESTED LOOPS AND SORTING

Instructional Periods 4 Laboratory Periods 2

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
43	Intro. Act. p. 261	pp. 262 - 264	pp. 264 - 265 Exer. One: 1, 2a	pp. 263-264	Study pp. 262 - 264 Solve pp292-293: 1, 3a p200: 6c p201: 7b, 12 p254: 3d
44	pp. 264 - 265 Exer. One: 2b, 3	pp. 267 - 274	pp. 270 - 271 Exer. Two: 1, 2 pp. 274 - 275 Exer. Three: 1a, b, 3	pp. 273-274	Study pp. 267 - 274 Solve pp292-293: 2, 3c p255: 6f p256: 9c, 10e p224: 7c, 9d, 11
45	p. 271 Exer. Two: 3	pp. 276 - 282	pp. 281 - 282 Exer. Four: 1, 2	pp. 280-282	Study pp. 276 - 282 Solve pp292-293: 4a, c, 5a, b, 7a, b, 10a p258: 15 p223: 1d, e, 3c
46	pp. 274 - 275 Exer. Three: 2	pp. 282 - 283	pp. 274 - 275 Exer. Three: 1c, d pp. 281 - 282 Exer. Four: 3	pp. 282-283	Study pp. 282 - 283 Solve pp292-293: 7c, d, 11 p259: 20 p223: 3f, 5e p201: 10
47	Laboratory Period ... Pages 283 - 291				
48	Laboratory Period ... Pages 283 - 291				

DESCRIPTION

This Topic will combine the concepts of looping using FOR-NEXT statements and subscripted variables to execute programs in finding the greatest or smallest number in a list, or arranging the numbers in a list in ascending or descending order.

NOTES TO THE TEACHER

Page 263. Emphasize the points made under the heading "Note."

Page 264. The broken line rectangles of the flow chart serve to

enhance the concept of nested loops - one loop contained within another.

Page 272. The process of switching can be motivated by holding up two containers, each containing a different color of water. Ask the students how one could exchange the contents of the two containers without losing any water or mixing the colors. They should respond by suggesting the use of a third container as a temporary holder for the contents of one of the original containers while that container is filled with the second color of water. Then, the other original container can be filled from the temporary holding container. The difference between this situation and the switching process used in the computer is that the temporary storage container in the computer (a variable) continues to hold its contents after the complete exchange has been made. Thus, one quantity is stored in two locations in the computer.

TOPIC 10 ALPHAMERIC OUTPUT AND INPUT

Instructional Periods 3 Laboratory Periods 2

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
49	Intro. Act. p. 295	pp. 296 - 298	p. 298 Exer. One: 1a, b, c, 2, 4	p. 297	Study pp. 296 - 298 Solve p292: 5b, 6c p293: 10c p225: 14 p316: 1, 2
50	p. 298 Exer. One: 3	pp. 300 - 303	p. 303 Exer. Two: 1, 2, 3a	pp. 302-303	Study pp. 300 - 303 Solve pp. 316 - 318: 3a, c, 4a, 6c, 8, 10 p293: 8 p259: 20
51	p. 303 Exer. Two: 3b, c	pp. 306 - 311	pp. 308 - 309 Exer. Three: 1, 2, 3	p. 310	Study pp. 306 - 311 Solve pp. 316 - 318: 5a, b, 6a, 7, 9, 12 p225: 17
52	Laboratory Period ... Pages 311 - 316				
53	Laboratory Period ... Pages 311 - 316				

DESCRIPTION

In this Topic, the student will learn how to input and output alphabetic and numeric data in a different manner than previously used. The string variable and subscripted string variable allow the flexibility of altering alphameric information when used in conjunction with a DATA statement.

NOTES TO THE TEACHER

Page 296. A string variable is a versatile tool which permits inputting and outputting of information. This information may vary for the same program from one execution to the next by simply altering the DATA statement(s).

Page 307. Note the days of the week printed out on the same line. This is achieved by use of the semicolon in the PRINT statement, line 40.

TOPIC 11 TWO-DIMENSIONAL ARRAYS

Instructional Periods 3 Laboratory Periods 2

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
54	Intro. Act. p. 319	pp. 321 - 324	p. 324 Exer. One: 1, 2	pp. 322-324	Study pp. 321 - 324 Solve p350: 1, 3, 4, 5 p254: 3e, f p258: 16 p292: 3b, d p317: 5c p318: 11
55	p. 325 Exer. One: 3	pp. 326 - 330	p. 331 Exer. Two: 1, 2, 4a, b	pp. 327-330	Study pp. 326 - 331 Solve p350: 6 pp352-353: 10, 11, 15 p254: 5d p292: 5c p316: 3b
56	p. 331 Exer. Two: 4c, d, 5	pp. 332 - 338	pp. 338 - 340 Exer. Three: 1, 2, 3, 4, 5	p. 342	Study pp. 332 - 342 Solve p350: 2 p353: 12, 14 p292: 6d p293: 9

57	Laboratory Period ... Pages 343 - 350
58	Laboratory Period ... Pages 343 - 350

DESCRIPTION
The student will be shown how to enter and print two-dimensional matrices using the MAT statements.

NOTES TO THE TEACHER

Page 324. Re-emphasize the fact that subscripts should always be non-negative integers. In some computer systems, the element stored in the first row / first column is called A(0,0) - allowing "0" to be a valid subscript. Check your system for the correct subscripts.

Page 326. In some systems, the statement 10 DIM A(3,4) will tell the computer to set aside enough space for a 4 by 5 matrix. Check your system.

Page 328. MATrix operations in BASIC allow the programmer to manipulate data in a simple manner, as opposed to writing complex subprograms that do the same thing.

Page 329. A comma is recommended in the PRINT statement of figure 11.5 if you want the columns to line up evenly.

Page 334. Have students trace through the flow charts to manually find the sum.

Page 336. The program as shown will only work with a 4 by 4 matrix. Note the number of times the number 4 appears in the FOR statements.

Page 337. MAT READ instructions cannot be used in the Employee Stat Sheet program since alphabetic and numeric data are mixed in the DATA statements.

TOPIC 12 FUNCTIONS AND SUBROUTINES

Instructional Periods 3 Laboratory Periods 2

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
59	Intro. Act. p. 355	pp. 356 - 359	pp. 359 - 360 Exer. One: 1, 2	pp. 356-359	Study pp. 356 - 361 Solve p385: 1, 2a, b, c, 5, 6 p387: 17 p255: 7d p293: 10b p351: 7a, b p353: 13
60	p. 360 Exer. One: 3, 4	pp. 362 - 366	p. 366 Exer. Two: 1a, b, 2	pp. 362-365	Study pp. 360 - 369 Solve p385: 4, 7 p386: 10, 11, 12 p387: 16 p257: 11b p317: 4b
61	pp. 367 - 368 Exer. Two: 1c, d, 3, 4	pp. 370 - 376	p. 376 Exer. Three: 1, 2, 3, 4	p. 378	Study pp. 370 - 378 Solve p385: 3 p386: 13, 14 p387: 19, 20 p293: 9 p352: 7c, d, e, f
62	Laboratory Period ... Pages 378 - 384				
63	Laboratory Period ... Pages 378 - 384				

DESCRIPTION

The student will be shown how to create functions and subroutines that will allow the programmer to save many steps.

NOTES TO THE TEACHER

Page 357. DEF FNA (I,J,K) tells the computer to "define the function which we will name A to be the result of arithmetic operations described on the right side of the equal sign." Function A will be dependent upon three variables. I,J, and K are placeholders or "dummy variables" that can be replaced by other variable names or numerical expressions.

Page 359. In the third example 20 LET P = FND(X(I),Y(I)) subscripted

values are used as arguments. When the function is defined, subscripted variables are not allowed.

Page 363. Upon seeing the RETURN statement in a subroutine, the computer transfers control to the line immediately following the GOSUB statement.

Page 374. The program of figure 12.14 can give rise to some interesting discussion questions.

(1) Why was "0" chosen to be the "returned" value for F if F were not a factor of N?

(2) What would happen if line 40 were changed to 40 FOR F=1 TO N/2?

Page 376. Don't expect the computer to print the perfect numbers immediately, for there are many calculations that need to be performed for each integer tested.

TOPIC 13 MATRIX ALGEBRA

Instructional Periods 3 Laboratory Periods 2

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
64	Intro. Act. p. 389	pp. 389 - 395	p. 397 Exer. One: 1a, b, 2a, 4	pp. 390-395	Study pp. 389 - 397 Solve p423: 1a, c, f p425: 2a, c p426: 3, 4b p427: 7a p428: 9a p292: 4b, d p354: 16
65	p. 397 Exer. One: 1c, 2b, 3	pp. 399 - 404	pp. 404 - 405 Exer. Two: 1a, b, 2a, 3 4a, b, 5	pp. 399-404	Study pp. 399 - 405 Solve p423: 1b, d, e p425: 2b, d p426: 6a, b, c p427: 7c p385: 2d, e, f
66	pp. 404 - 405 Exer. Two: 1c, 2b, 4c	pp. 406 - 413	p. 413 Exer. Three: 1-4	pp. 414-415	Study pp. 406 - 415 Solve p426: 4a, c p427: 7b, d p428: 9b p352: 8, 9 p387: 15
67	Laboratory Period ... Pages 415 - 423				
68	Laboratory Period ... Pages 415 - 423				

DESCRIPTION

The student will be able to use "built-in" BASIC instructions to perform what otherwise might be a complicated task of adding, subtracting, or multiplying two matrices.

NOTES TO THE TEACHER

Page 390. By adding the corresponding entries of the M-array and T-array, the values shown in the answer to problem 4 are found.

Page 393. The statement 40 MAT C = A + B replaces the following set of BASIC statements:

```
40 FOR I = 1 TO 5
41 FOR J = 1 TO 3
42 LET C(I,J) = A(I,J) + B(I,J)
43 NEXT J
44 NEXT I
```

Page 395. An interesting exercise would be to write the BASIC program to do matrix subtraction if the MAT statement was unavailable.

Page 404. An interesting exercise would be to perform the matrix multiplication shown in figure 13.6 without the use of the MAT statement.

Page 410. Matrix algebra can be performed on only two matrices at one time. Lines 160 and 161 in figure 13.8 divide the sum of the matrices N, W, and T into two parts so that it can be performed by the computer.

Page 415. For the more advanced student, assign a project to solve systems of simultaneous equations using the MAT instruction for inverting a matrix.

TOPIC 14 CONVERGING PROCESSES

Instructional Periods 3 Laboratory Periods 2

Suggested Daily Lessons					
Lesson	Opening	Development-Discovery	Reinforcement	Summary	Home Assignment
69	Intro. Act. p. 431	pp. 432 - 433	p. 433 Exer. One: 1, 2	pp. 432-433	Study pp. 431 - 434 Solve p448: 1 p449: 2, 3 p450: 4 p317: 6b, d p387: 18
70	p. 433 Exer. One: 3, 4	pp. 434 - 438	p. 438 Exer. Two: 1, 2, 3	pp. 434-438	Study pp. 434 - 438 Solve p450: 5, 6, 7, 8 p386: 8a, b, 9 p429: 9c

71	p. 438 Exer. Two: 4, 5	pp. 441 - 443	p. 443 Exer. Three: 1-4	pp. 444-445	Study pp. 441 - 445 Solve p450: 9 p451: 10 p426: 5 p427: 7e, 8
72	Laboratory Period ... Pages 445 - 448				
73	Laboratory Period ... Pages 445 - 448				

DESCRIPTION

The student will be introduced to the converging processes method (or numerical method) for solving problems.

NOTES TO THE TEACHER

Page 432. Numerical methods for solving problems can be used on high speed computers because the amount of time needed to substitute an "answer" and to test for the correct solution can be measured in thousandths or even millionths of a second.

Page 436. The sign check step and the test step can be combined. In figure 14.15, line 40 could read

```
40 IF ABS(S-X) < .001 THEN 80
```

thereby eliminating the need for line 30.

Page 441. Newton's Method for solving equations is an example of using a repeating formula to force a solution.

Page 443. By keeping track of the value of H each time through the loop, you can also find the total vertical distance traveled by the bouncing ball.

SECTION III

ANSWERS TO PROBLEM SETS

ANSWERS TO PROBLEM SET 1

1. d. The computer can think.

2. d. Write down the two numbers.
   a. Subtract the second number from the first.
   c. Write the result.
   b. Stop, the problem is solved.

3. a.
   Step 1: 64.0 - 19.0
   Step 2: 45.0
   Step 3: 45.0
   Step 4: Stop

   b.
   Step 1: 38.17 - 29.98
   Step 2: 8.19
   Step 3: 8.19
   Step 4: Stop

4.
```
30 LET D = 64.0 - 19.0
40 PRINT D
```

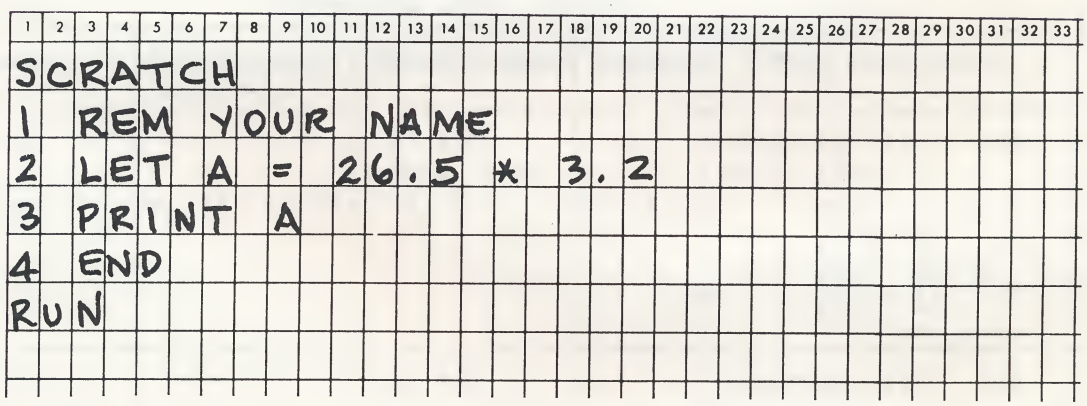
5. Step 1: Write down the two numbers.
   Step 2: Divide the second number into the first.
   Step 3: Write the result.
   Step 4: Stop, the problem is solved.

6. Step 1: 24.0 / 0.12
   Step 2: 200
   Step 3: 200
   Step 4: Stop

7. 28.05

8. a. + b. - c. * d. /

9. a.



Missing REM

b.

```
SCRATCH
1 REM YOUR NAME
2 LET Q = 56.5/21.2
3 PRINT Q
4 END
RUN
```

Missing LET

c.

```
SCRATCH
1 REM YOUR NAME
2 LET R = 20.2 * 5.6
3 PRINT R
4 END
RUN
```

PRINT not PIRNT

d.

```
SCRATCH
1 REM YOUR NAME
2 LET X = 36 + 51
3 PRINT X
4 END
RUN
```

No END statement

e.

```
SCRATCH
1 REM YOUR NAME
2 LET Y = 58.2 + 36.1 - 12.8
3 PRINT Y
4 END
RUN
```

No line number before END

f.

```
SCRATCH
1 REM YOUR NAME
2 LET A = 56 + 81
3 PRINT A
4 END
RUN
```

Missing LET

10.
a. No
b. No
c. Yes
d. Yes
e. No
f. No
g. No
h. Yes

11.

```
SCRATCH
1 REM NAME
2 REM PROBLEM 11,SET 1
3 LET P = 34.5*414.99*57.7
4 PRINT P
5 END
RUN
```

12.

```
SCRATCH
1  REM NAME
2  REM PROBLEM 12, SET 1
3  LET S = 333.3 + 976.84
4  LET Q = S/2
5  PRINT Q
6  END
RUN
```

13.

```
SCRATCH
1  REM NAME
2  REM PROBLEM 13, SET 1
3  LET T = 787.54 + 345.66 - 218.79
4  LET B = 36.4 * 45.7
5  LET Q = T/B
6  PRINT Q
7  END
RUN
```

14.

```
10 REM NAME
20 REM PROBLEM 14, SET 1
30 LET S=7.50+3.75+2.50+8.75
40 PRINT S
50 END

RUN

 22.5
```

15.

```
10 REM NAME
20 REM PROBLEM 15, SET 1
30 LET S=78+83
40 LET P=2*S
50 LET N=P+95

60 LET O=N/5
70 PRINT O
80 END

RUN
```

16.

```
SCRATCH
10  REM  GAY  HOLLAND
20  REM  PROBLEM  16
30  LET  T  =  95.1  +  143.2
40  LET  B  =  3.2  +  11.4
50  LET  Q  =  T/B
60  PRINT  Q
70  END
RUN
```

17.

```
10 REM NAME
20 REM PROBLEM 17, SET 1
30 LET S=88.4+67.3
40 LET A=88.4-67.3
50 LET Q=S/A
60 PRINT Q
70 END

RUN

 7.37915
```

ANSWERS TO PROBLEM SET 2

1. a. An arithmetic expression, in this case X+Y, may not appear to the left of the = symbol.
   b. The keyword REM must appear immediately after the line number.
   c. There is no such keyword as PLINT. Should be PRINT.
   d. Only a valid BASIC variable may immediately follow the word LET.
   e. A,N is not a valid BASIC variable.
   f. There is no error in the statement.
   g. A left parenthesis, (, is missing.
   h. There is no error.
   i. The keyword LET is not followed by a formula which includes the symbol =.
   j. 12 is not a valid BASIC variable.

2. a.

A	B	C
3	2	0
3	2	5
4	2	5
4	8	5
4	8	13
3	8	13

   b.

I	J
0	5
1	5
1	4
16	4
16	12
784	12

3. a. addition
   b. subtraction
   c. multiplication
   d. multiplication
   e. exponentiation
   f. addition
   g. subtraction
   h. multiplication
   i. subtraction

4. Value Table
   X = 1
   Y = 1
   X = 2
   D = 2
   E = 7
   F = 6
   G = 18
   H = 14
   Q = 27

5. a. A = B * H
   b. A = 3.1416 * R↑2
   c. A = (B * H)/2
   d. S = 2 * (H*W + H*L + L*W)
   e. V = (3.1416 * R↑2 * H)/3
   f. V = 4/3 * 3.1416 * R↑3 or V = 4*(3.1416*R↑3)/3
   g. V = (3.1416 * H * (R1↑2 + R1*R2 + R2↑2))/3
   h. A = (3↑.5 * S↑2)/4
   i. V = H/3 * (B1 + (B1 * B2)↑.5 + B2)

6. a.

```
10 REM PROBLEM 6
20 LET P=13000
25 LET R=.05
30 LET T=2
35 LET I=P*R*T
40 PRINT I
45 END

>>RUN

 1300
```

b.

```
10 REM PROBLEM 6
20 LET I=198
25 LET P=432
30 LET N=36
35 LET R=(24*I)/(P*(N+1))
40 PRINT R
45 END

>>RUN

 .2972973
```

c.

```
10 REM PROBLEM 6
20 LET C=100
25 LET R=C/(2*3.1416)
30 PRINT R
35 END

>>RUN

 15.915457
```

ANSWERS TO PROBLEM SET 3

1. a. invalid b. invalid c. valid d. valid

2. a. Missing quote mark.
   10 PRINT X, 'IS A FACTOR OF',Y
   b. Missing quote marks.
   10 PRINT 'X = 5'
   c. Missing quote mark.
   10 PRINT 34 + 73/12, 'IS THE ANSWER'
   d. $ symbol must appear within quotes.
   10 PRINT 'THE SALARY IS $', 12000

3. a.
```
20 READ I
25 DATA 6
```
b.
```
30 READ G
35 DATA 32.5
```

4. a.
```
40 INPUT S
?57.03
```
b.
```
40 INPUT A,B
?78.2,62
```
c.
```
40 INPUT X,Y,Z
?24.3,.00002, 19.46
```

5. a. 4,800,000
b. 66,600,000
c. .000909
d. .0888775
e. 12,345,600,000
f. .00000110564

6. a. 12
b. THE AREA IS 16 SQUARE CENTIMETERS
c.
```
HOURS WORKED = 35
RATE PER HOUR = 2.5
WAGES EARNED = 87.5
```
d.
```
TOTAL GAMES = 100  GAMES WON = 75
GAMES LOST = 25

WON - LOST PERCENTAGE = .75
```

7. a. X = 39
b. X = 98
c. X = 7.4
d. X = 7

8.
```
50 PRINT 35 + 72; 'IS THE SUM'
```
(in this and some of the following problems, line numbers may vary)

9.
```
50 PRINT 'THE NUMBER OF HEADS IS';T/2;'OUT OF';T;'TOSSES'
```

10. a.
```
10 INPUT X
20 LET Y = X↑2
30 PRINT Y
40 END
 ? 92.3
```
b.
```
10 INPUT M,N
20 LET X = (M*3)/4
30 PRINT X
40 END
 ?36,9
```

11. a.
```
10 READ Z
20 LET A = 3 + Z↑2
30 PRINT A
35 DATA 5.3
40 END
```
b.
```
10 READ A,B,C
20 LET Y = A + B - C
30 PRINT Y
35 DATA 45,14,2
40 END
```

12. a.
```
10 READ L
20 PRINT 'L IS EQUAL TO'; L
30 DATA 8
```
b.
```
10 READ M
20 PRINT 'THE MASS IS'; M
30 DATA 325
```
c.
```
10 READ R
20 PRINT 'RADIUS ='; R
30 DATA 2.25
```
d.
```
10 READ D
20 PRINT 'YOU OWE'; D;'DOLLARS'
30 DATA 138
```

e.
```
10 READ C
20 PRINT 'THE CIRCUMFERENCE IS'; C; 'CENTIMETERS'
30 DATA 27.371
```

13. a.
```
30 PRINT 39↑2*.0034
```
b.
```
30 PRINT 2.34351/(27*64)
```
c.
```
30 PRINT 31 + 79 - 64
```
d.
```
30 PRINT (54 + 68 + 73)/3
```

14.
```
5 REM PROBLEM 14 SET 3
10 READ A,R
20 LET T = (A/100)*R
30 PRINT T
40 DATA 27800,6.45

>>RUN

1793.1
```

15.
```
5 REM PROBLEM 15 SET 3
10 READ K
20 LET P = 2.2*K
30 PRINT P
40 DATA 64
50 END

>>RUN

 140.8
```

16.
```
5 REM PROBLEM 16 SET 3
10 INPUT R
20 LET A = 3.14159*R↑2
30 PRINT A
40 END

>>RUN

? >7
 153.93791
```

17.

```
5 REM PROBLEM 17 SET 3
10 INPUT A,B
20 LET P=A*B
30 PRINT P
40 END

>>RUN

? >9.72,5.4
 52.488
```

18.

```
5 REM PROBLEM 18 SET 3
10 READ L,W
20 PRINT 'LENGTH=';L
30 PRINT 'WIDTH=';W
40 LET P = 2*L+2*W
50 PRINT P; 'METERS OF FENCE NEEDED'
60 DATA 12,4
70 END

>>RUN

LENGTH = 12
WIDTH = 4
32 METERS OF FENCE NEEDED
```

19.

```
5 REM PROBLEM 19 SET 3
10 READ C,P,N
20 PRINT 'COST OF A COOKBOOK =';C
30 PRINT 'POSTAGE AND HANDLING =';P
40 PRINT 'NUMBER SOLD =';N
50 LET T = N*(C+P)
60 PRINT 'WEEKLY RECEIPTS =';T
70 DATA 2,.35,85
80 END

>>RUN

COST OF A COOKBOOK = 2
POSTAGE AND HANDLING = .35
NUMBER SOLD = 85
WEEKLY RECEIPTS = 199.75
```

20.

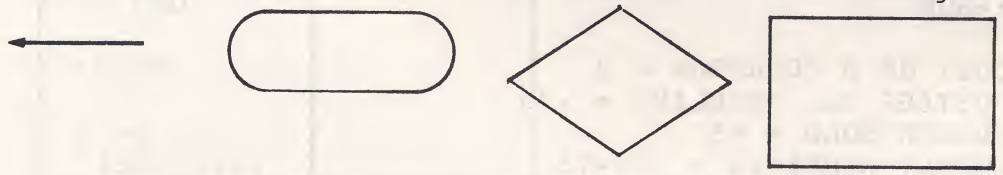
```
5 REM PROBLEM 20 SET 3
10 READ H,R,R1
20 PRINT 'HOURS WORKED =';H
30 PRINT 'RATE =';R
40 LET H1 = H - 40
50 LET P = 40*R+H1*R1
60 PRINT 'WEEKLY EARNINGS =';P
70 DATA 56,2.75,4
80 END

>>RUN

HOURS WORKED = 56
RATE = 2.75
WEEKLY EARNINGS = 174
```

21.

```
5 REM PROBLEM 21 SET 3
10 READ R,H
20 PRINT 'RADIUS =';R
30 PRINT 'HEIGHT =';H
40 LET V=3.1416*R↑2*H
50 PRINT 'VOLUME OF CYLINDER IS';V
60 DATA 14,25.89
70 END

>>RUN

RADIUS = 14
HEIGHT = 25.89
VOLUME OF CYLINDER IS 15941.861
```

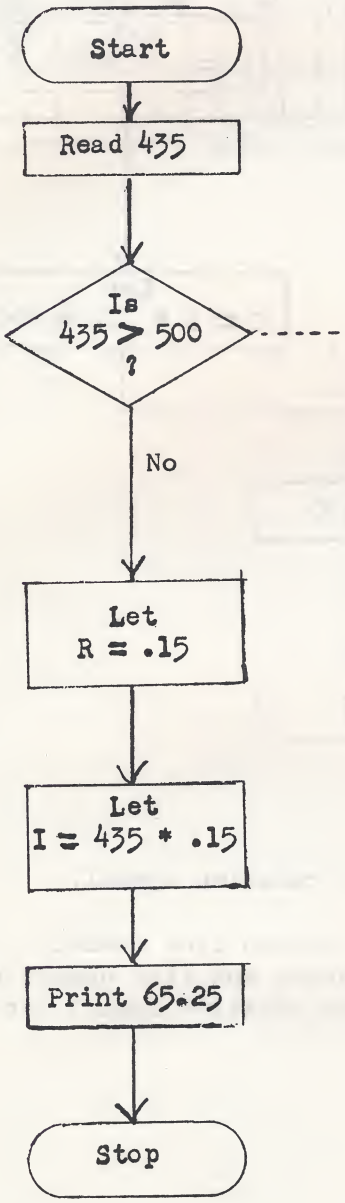
ANSWERS TO PROBLEM SET 4

1. a. arrow b. oval c. diamond d. rectangle

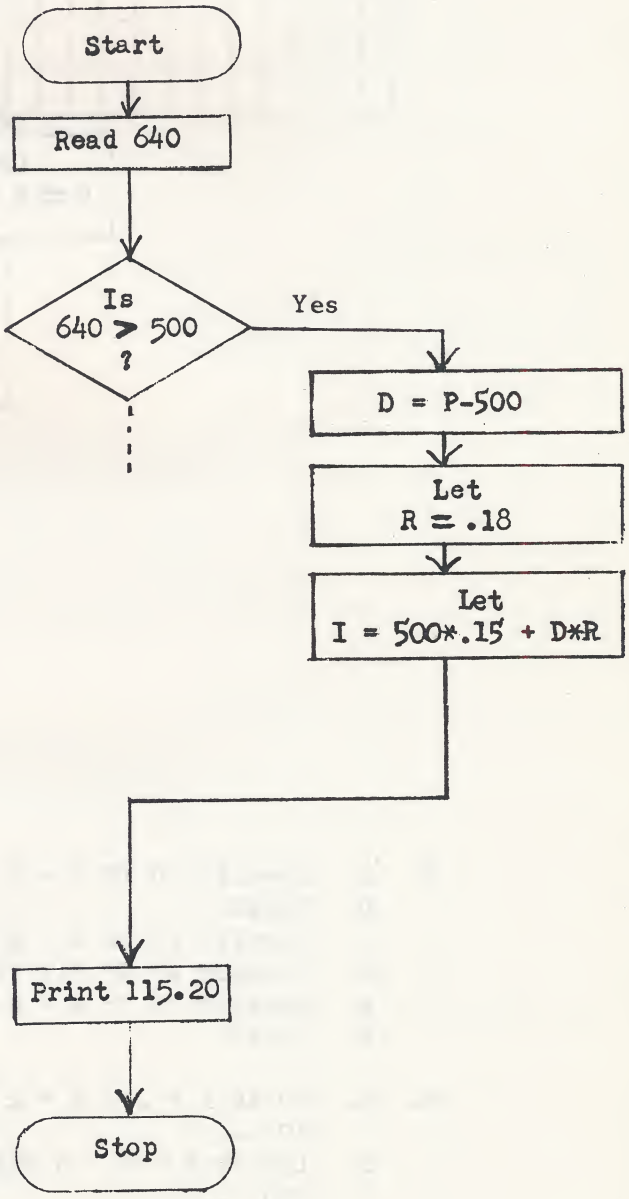


2.
```
10 READ Y, F
20 LET M1 = .91 * Y
30 LET M2 = .30 * F
40 LET M = M1 + M2
50 PRINT 'METERS = ', M
60 END
```

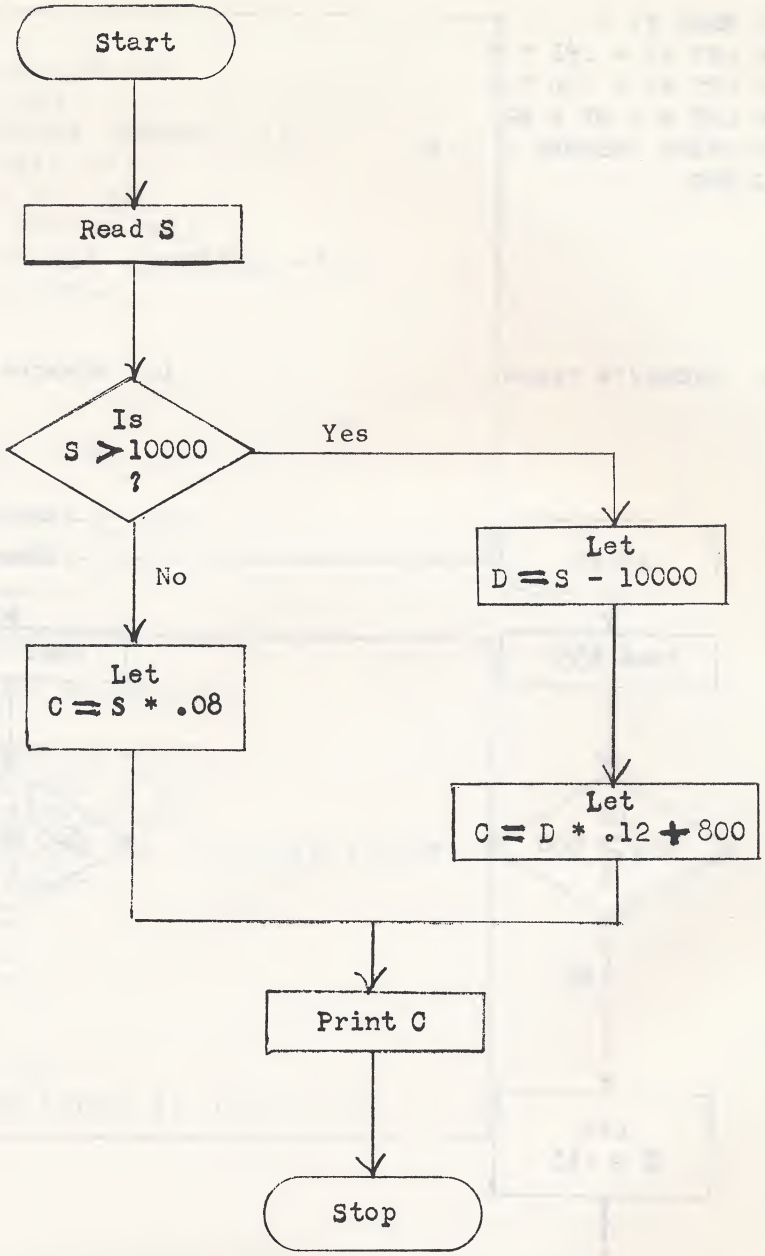
3. a. Sydney's trace



b. Roxanne's trace



4.



5. a. Invalid 10 IF A = B THEN 40 Missing relation symbol.
   b. Valid
   c. Invalid 10 IF A + B< = 15 THEN 96 Missing line number.
   d. Invalid 40 IF P1<>P2 THEN 83 IF missing and line number not START.
   e. Invalid 70 IF A = B THEN 180 Missing relation symbol not EQUALS.
   f. Valid

6. a.
```
30 IF A ↑ 2 < B * C THEN 80
40 ...
```
   b.
```
110 IF R + S > 0 THEN 200
120 ...
```

7. b. 65 IF A = 0 THEN 20
   c. 80 IF P< = Q THEN 100
   f. 75 IF A * B # C THEN 99

8. a. Invalid — 1980 GO TO 150
   b. Invalid — 70 GO TO 60
   c. Valid
   d. Valid
   e. Invalid — 30 GO TO 98
   f. Invalid — 2001 GO TO 175

9.

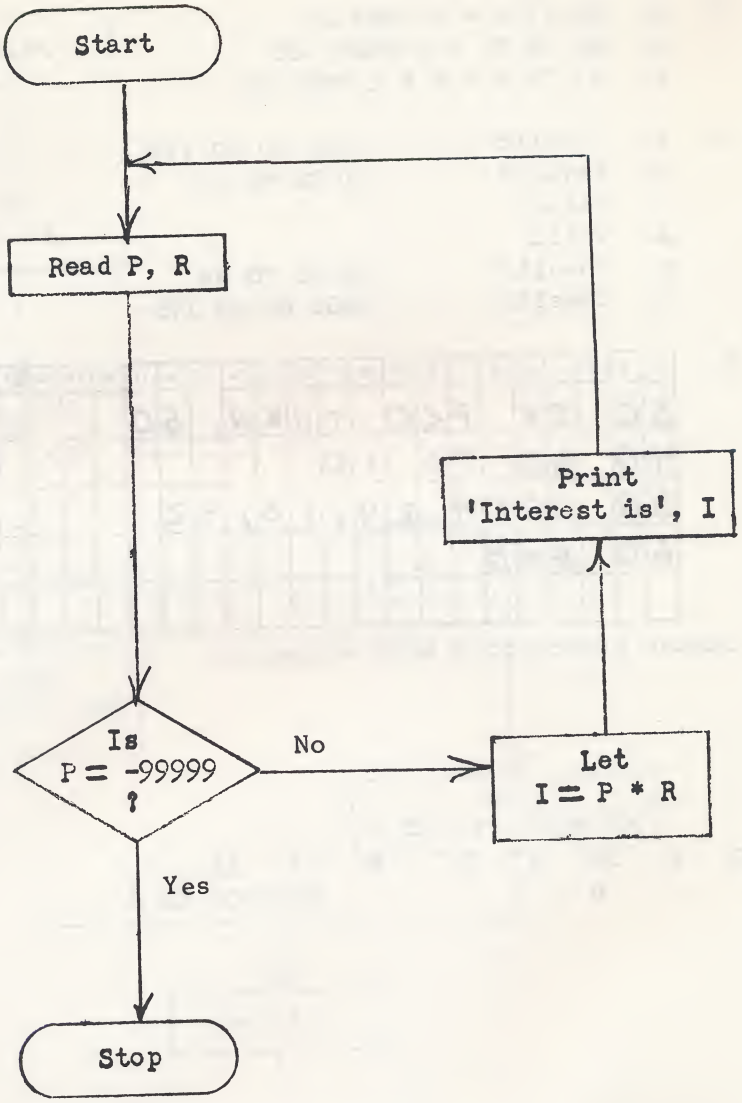
```
30 IF P<Q THEN 60
40 GO TO 10
50 DATA 24,16,92
60 END
```

Cannot branch to a DATA statement.

10. a. 28 2 5
    6

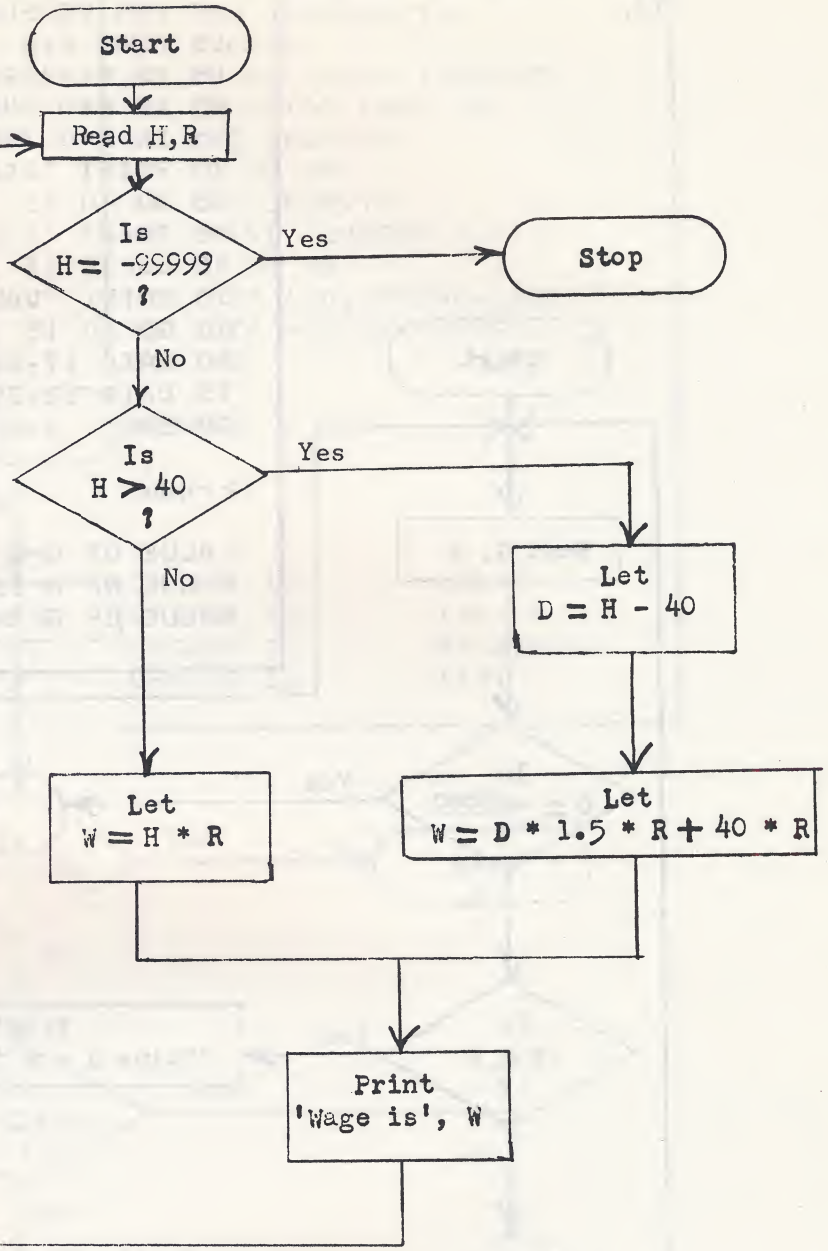
    b. 19 11 0
    DIVISOR IS 0

11.




```
10 REM PROBLEM 11
20 READ P,R
25 IF P=-99999 THEN 70
30 LET I=P*R
40 PRINT 'INTEREST IS',I
60 GO TO 20
65 DATA 350,.05,1400,.06
66 DATA 900 , .045,3850,.058
67 DATA -99999,-99999
70 END

>>RUN

INTEREST IS       17.5
INTEREST IS       84
INTEREST IS       40.5
INTEREST IS       223.3
```

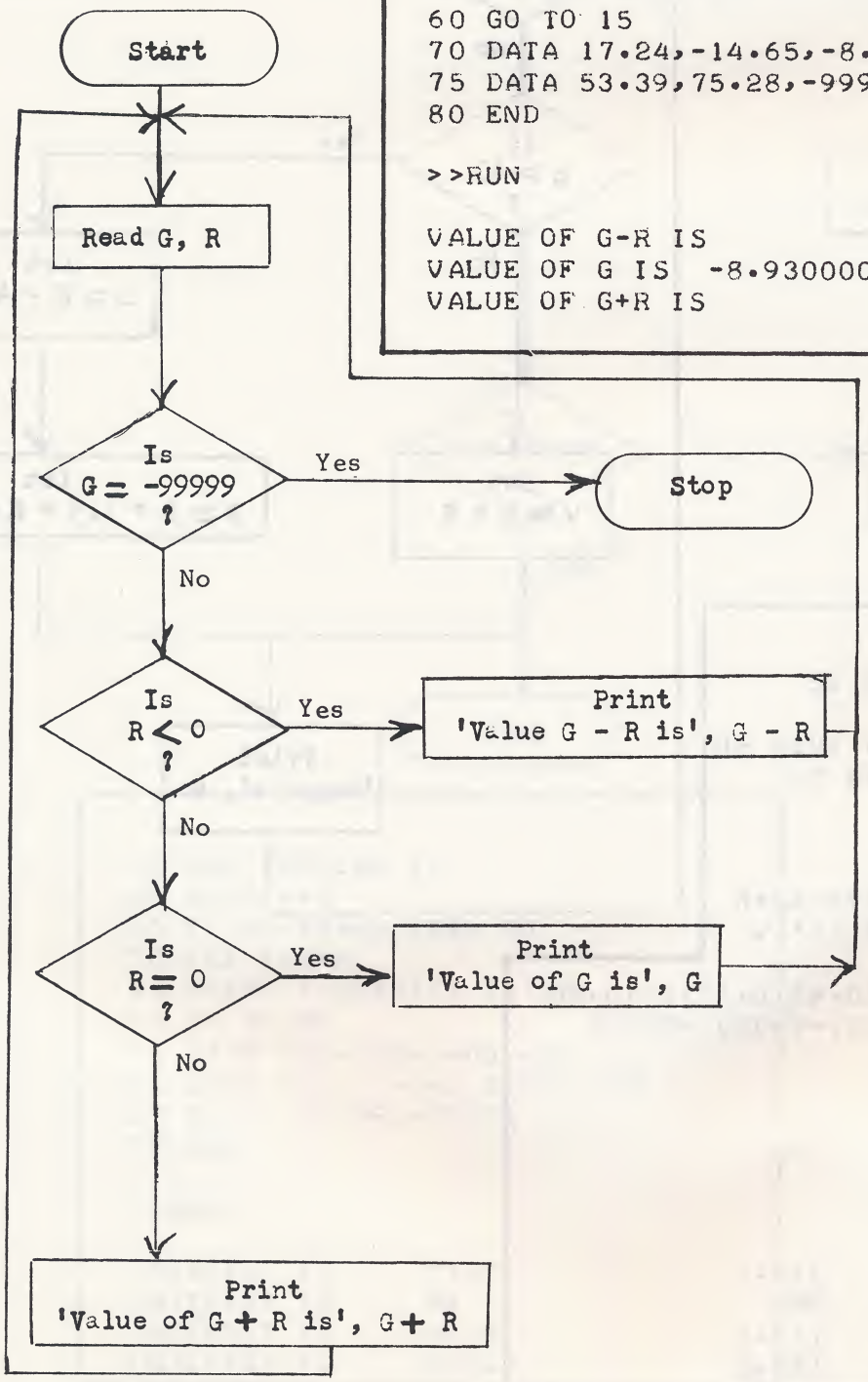
12.




```
10 REM PROBLEM 12
20 READ H,R
25 IF H=-99999 THEN 90
30 IF H>40 THEN 50
40 LET W=H*R
45 GO TO 70
50 LET D=H-40
60 LET W=D*1.5*R+40*R
70 PRINT 'WAGE IS',W
80 GO TO 20
85 DATA 38,5.60,45,6.40,24,4.80
88 DATA 24,7.30,-99999,-99999
90 END

>>RUN



WAGE IS          212.8
WAGE IS          304
WAGE IS          115.2
WAGE IS          175.2
```

13.

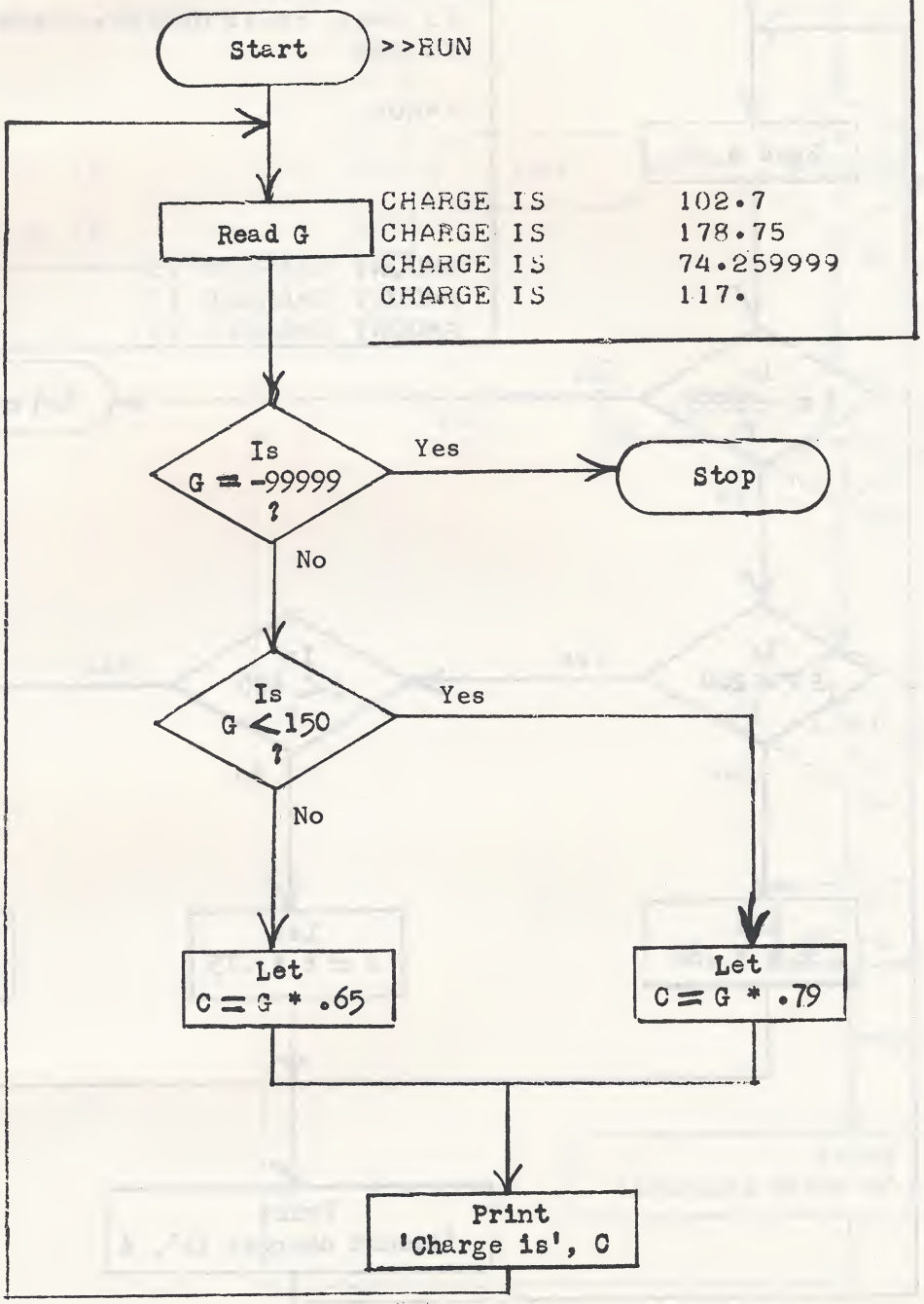
```
10 REM PROBLEM 13
15 READ G,R
18 IF G=-99999 THEN 80
20 IF R<0 THEN 40
25 IF R=0 THEN 50
30 PRINT 'VALUE OF G+R IS',G+R
35 GO TO 15
40 PRINT 'VALUE OF G-R IS',G-R
45 GO TO 15
50 PRINT 'VALUE OF G IS',G
60 GO TO 15
70 DATA 17.24,-14.65,-8.93,0.0
75 DATA 53.39,75.28,-99999,-99999
80 END

>>RUN

VALUE OF G-R IS                 31.89
VALUE OF G IS  -8.9300001
VALUE OF G+R IS                 128.67
```



14.

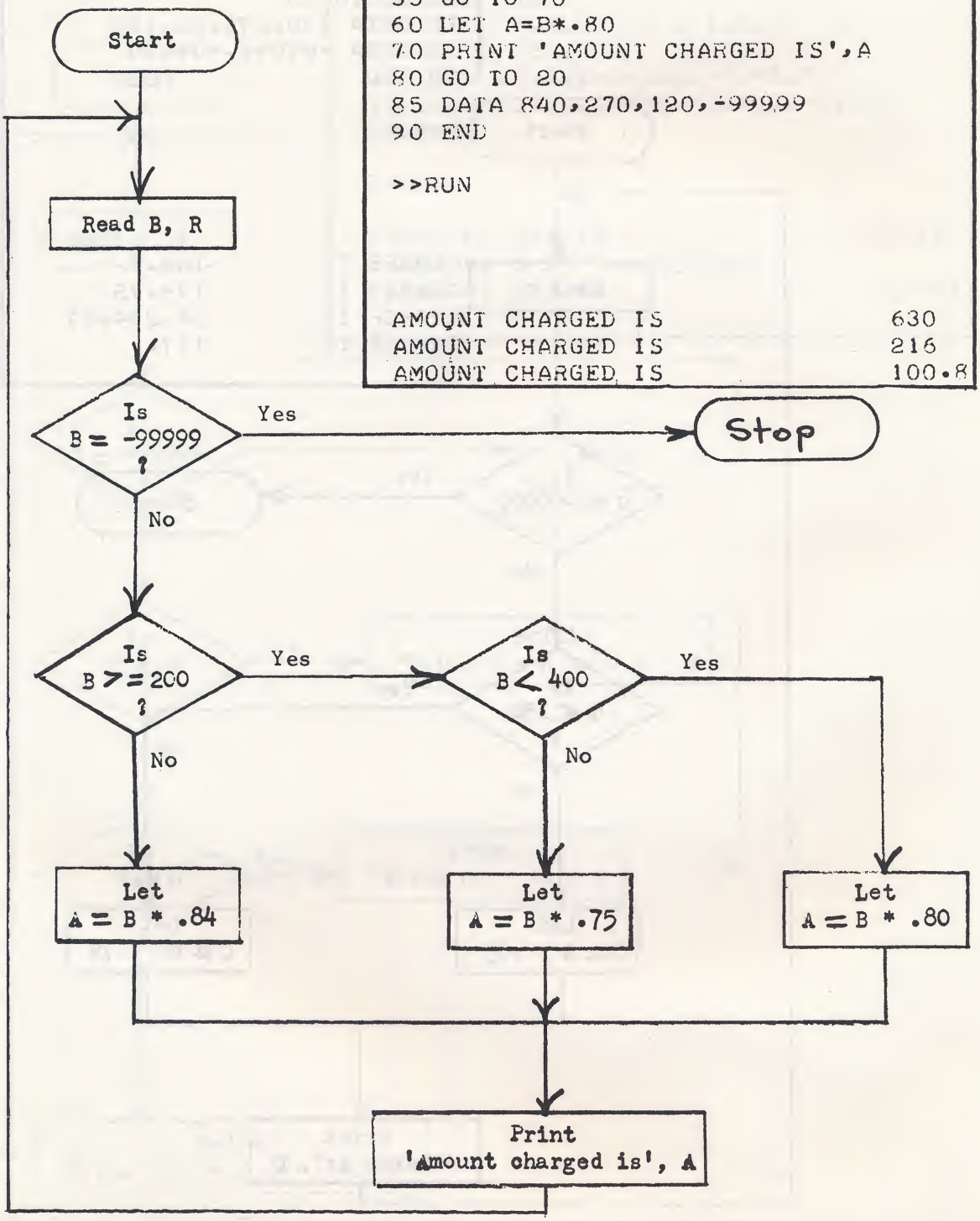
```
10 REM PROBLEM 14
20 READ G
25 IF G=-99999 THEN 80
30 IF G<150 THEN 50
40 LET C=G*.65
45 GO TO 60
50 LET C=G*.79
60 PRINT 'CHARGE IS',C
65 GO TO 20
70 DATA 130,275,94,180
75 DATA -99999,-99999
80 END
```

```
>>RUN
CHARGE IS          102.7
CHARGE IS          178.75
CHARGE IS          74.259999
CHARGE IS          117.
```



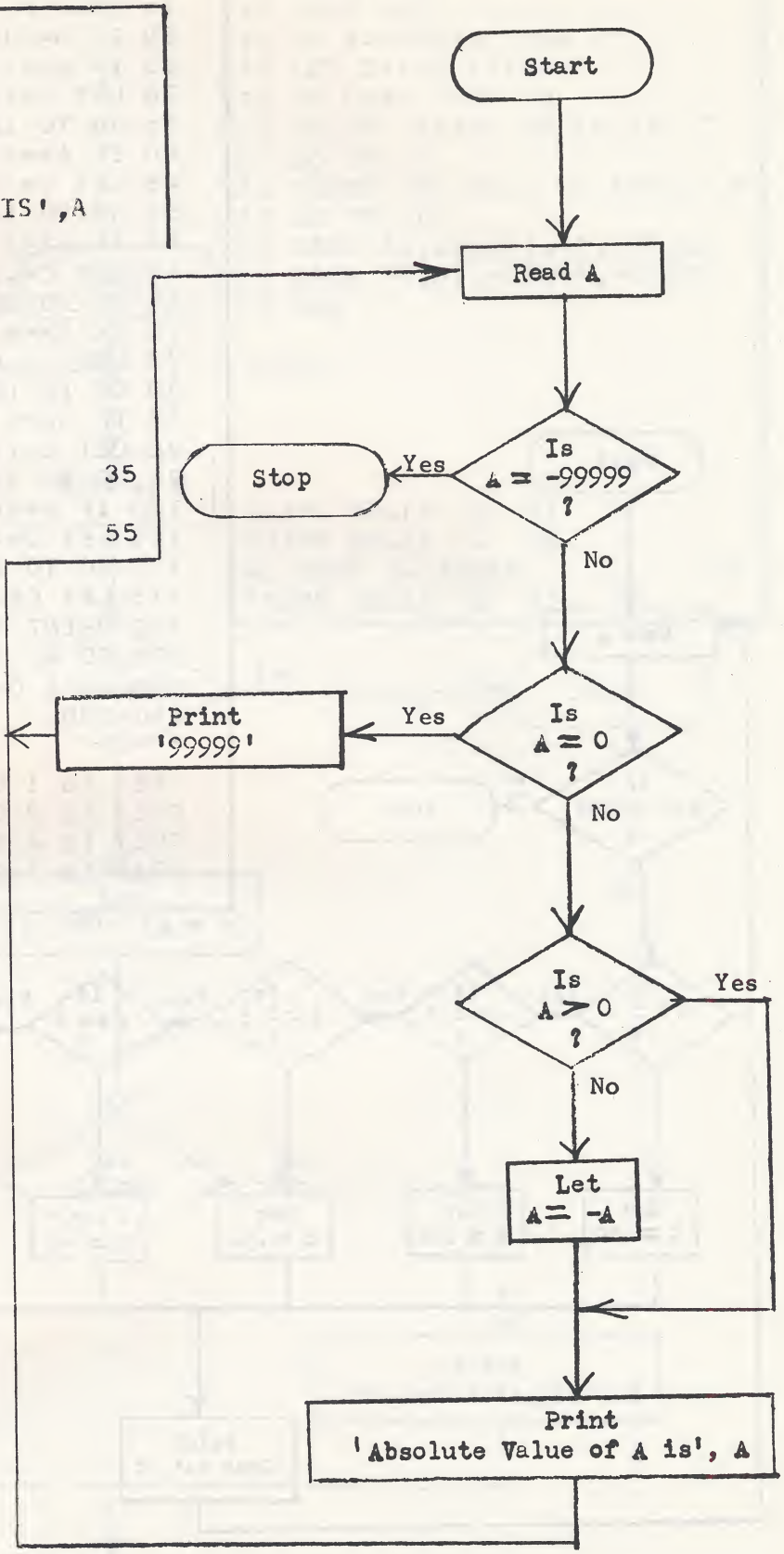
15.

```
10 REM PROBLEM 15
20 READ B
25 IF B=-99999 THEN 90
30 IF B>=200 THEN 45
35 LET A=B*.84
40 GO TO 70
45 IF B<400 THEN 60
50 LET A=B*.75
55 GO TO 70
60 LET A=B*.80
70 PRINT 'AMOUNT CHARGED IS',A
80 GO TO 20
85 DATA 840,270,120,-99999
90 END

>>RUN


AMOUNT CHARGED IS                630
AMOUNT CHARGED IS                216
AMOUNT CHARGED IS                100.8
```



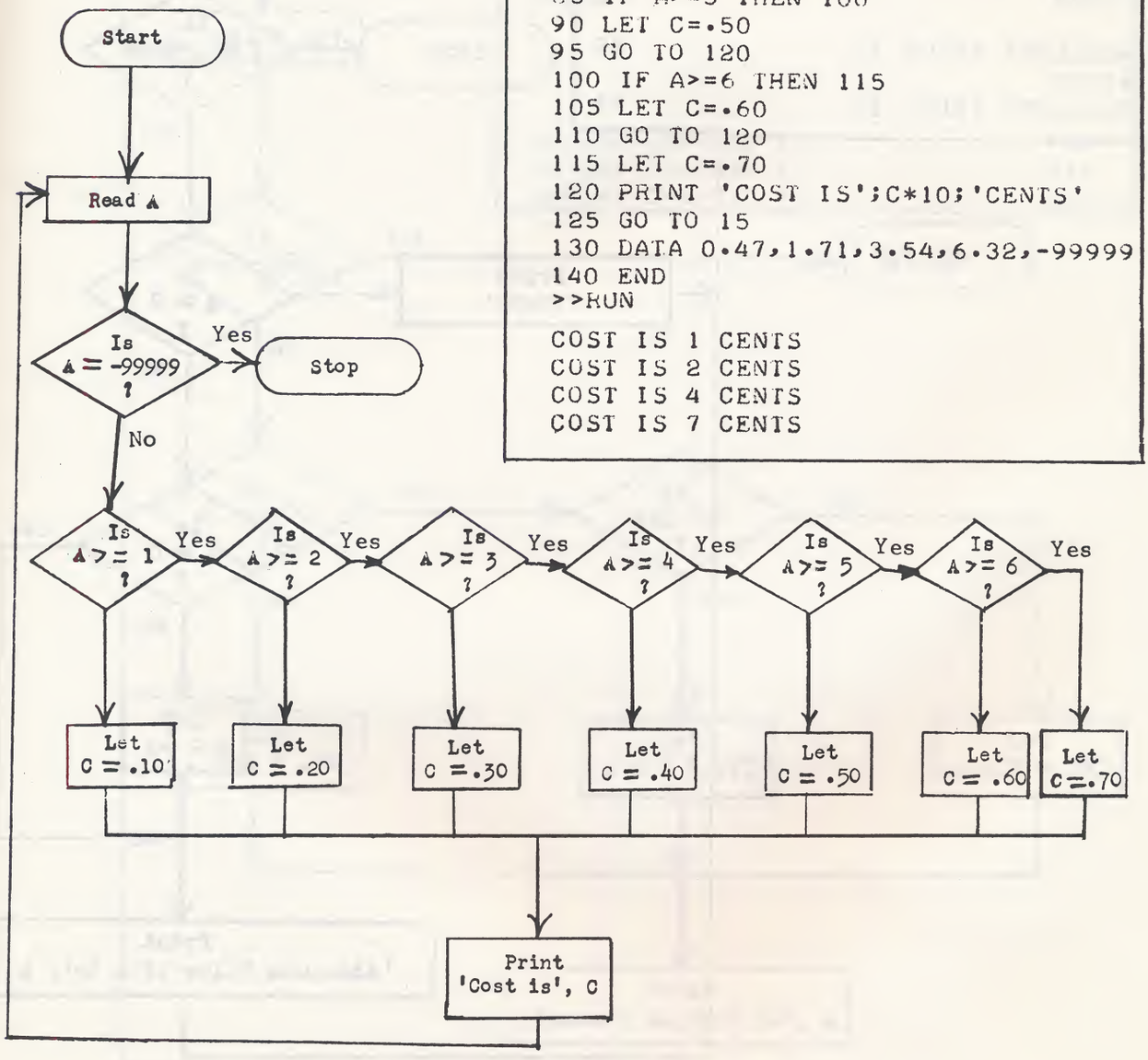
16.

```
10 REM PROBLEM 16
20 READ A
23 IF A=-99999 THEN 70
25 IF A=0 THEN 50
30 IF A>0 THEN 40
35 LET A=-A
40 PRINT 'ABSOLUTE VALUE IS',A
45 GO TO 20
50 PRINT '99999'
60 GO TO 20
65 DATA -35,0,55,-99999
70 END

>>RUN

ABSOLUTE VALUE IS              35
99999
ABSOLUTE VALUE IS              55
```



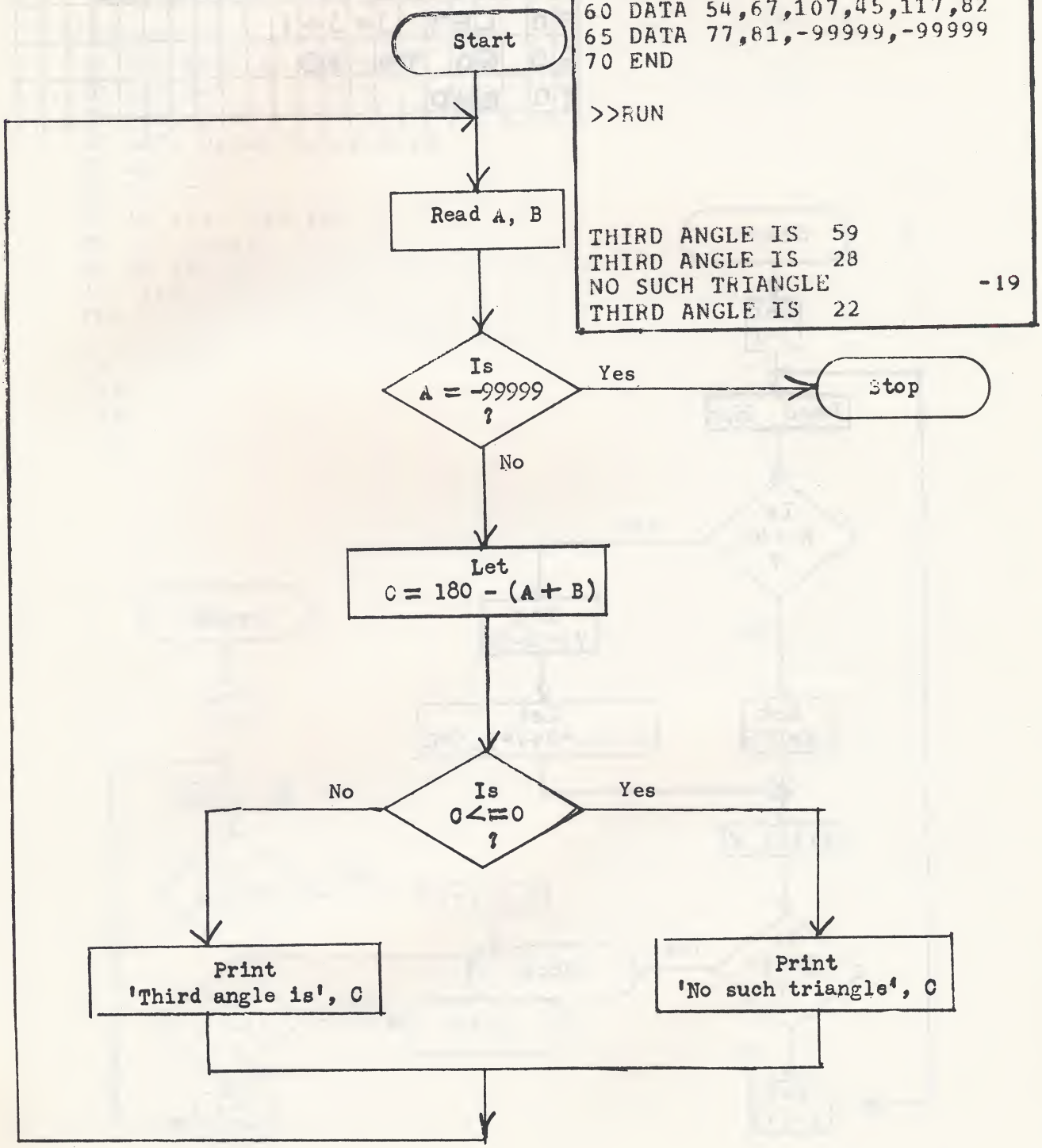
17.

```
10 REM PROBLEM 17
15 READ A
20 IF A=-99999 THEN 140
25 IF A>=1 THEN 40
30 LET C=.10
35 GO TO 120
40 IF A>=2 THEN 55
45 LET C=.20
50 GO TO 120
55 IF A>=3 THEN 70
60 LET C=.30
65 GO TO 120
70 IF A>=4 THEN 85
75 LET C=.40
80 GO TO 120
85 IF A>=5 THEN 100
90 LET C=.50
95 GO TO 120
100 IF A>=6 THEN 115
105 LET C=.60
110 GO TO 120
115 LET C=.70
120 PRINT 'COST IS';C*10;'CENTS'
125 GO TO 15
130 DATA 0.47,1.71,3.54,6.32,-99999
140 END
>>RUN

COST IS 1 CENTS
COST IS 2 CENTS
COST IS 4 CENTS
COST IS 7 CENTS
```



18.

```
10 REM PROBLEM 18
20 READ A,B
25 IF A=-99999 THEN 70
30 LET C=180-(A+B)
35 IF C<=0 THEN 50
40 PRINT 'THIRD ANGLE IS',C
45 GO TO 20
50 PRINT 'NO SUCH TRIANGLE',C
55 GO TO 20
60 DATA 54,67,107,45,117,82
65 DATA 77,81,-99999,-99999
70 END

>>RUN



THIRD ANGLE IS  59
THIRD ANGLE IS  28
NO SUCH TRIANGLE          -19
THIRD ANGLE IS  22
```



ANSWERS TO PROBLEM SET 5

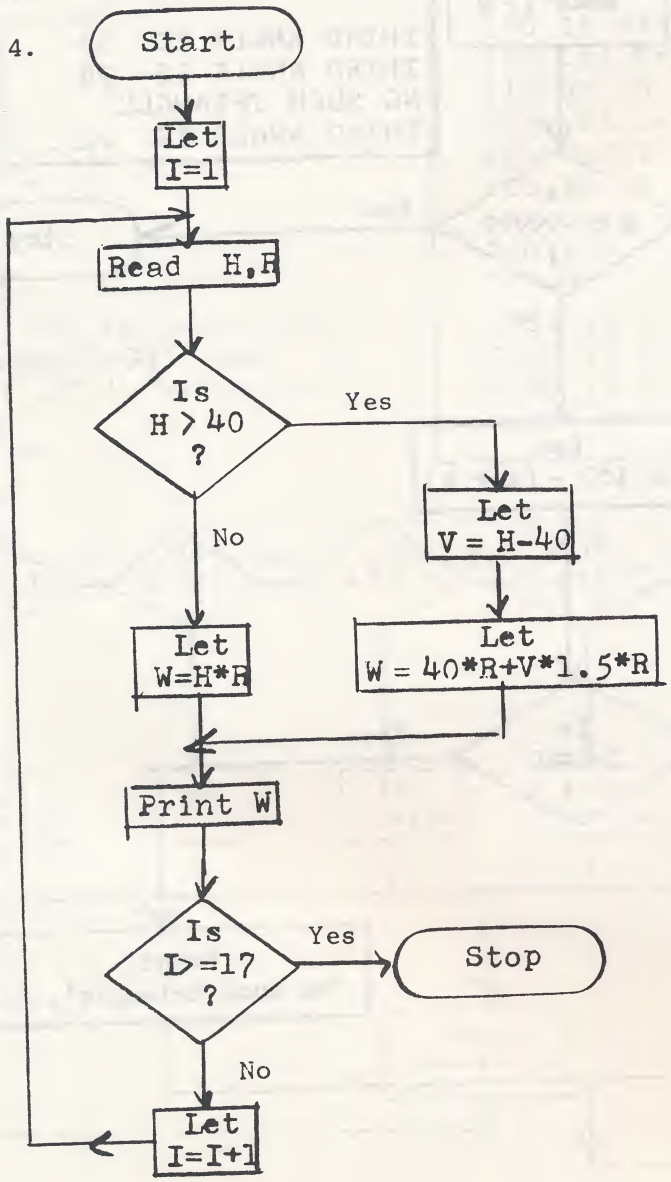
1. a. 3
   b. 9

2. a. 50
   b. 40
   c. 60
   d. 10
   e. 30

3.

```
10 REM PROBLEM 3, SET 5
20 LET J=11
30 PRINT J
40 IF J>=24 THEN 70
50 LET J=J+1
60 GO TO 30
70 END
```

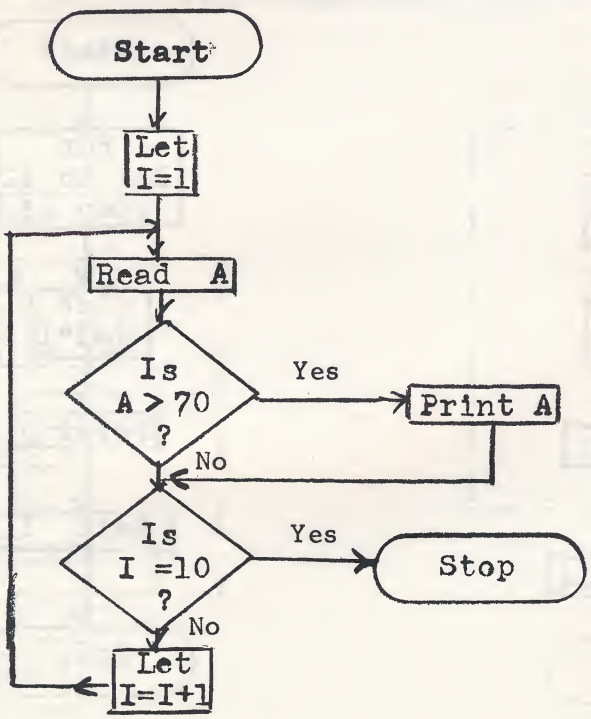
4.



5. The values of E will be printed - 2, 4, 6, 8, 10.
   Index - M
   Initial value step - 10 LET M=1
   Test step - 50 IF M>=5 THEN 80
   Increment step - 60 LET M=M+1
   Re-entry step - 70 GO TO 30
   Exit step - 80 END

6.
```
SCRATCH

READY
10 REM PROBLEM 6, SET 5
20 LET I=1
30 READ A,B
40 DATA 3,4,5,6,7,8,9,10
50 LET S=A+B
60 PRINT S
70 IF I=4 THEN 100
80 LET I=I+1
90 GO TO 30
100 END
RUN

 7
 11
 15
 19
```

7.



8. a.

```
20 LET J=J+2
```

b.

```
20 LET J=J+3
```

c.

```
20 LET J=J+5
```

d.

```
20 LET J=J+N
```

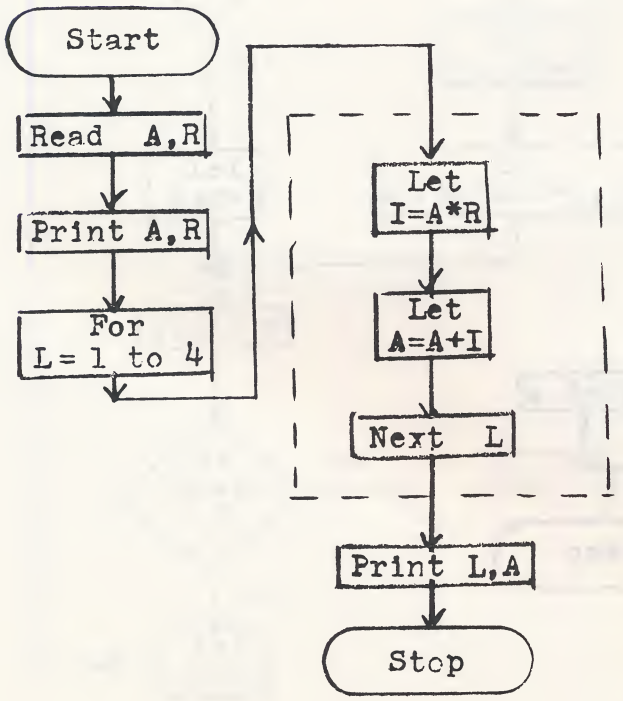
9. a. 40 LET I=I+2
   b. 30 IF I>=33 THEN 60

10.

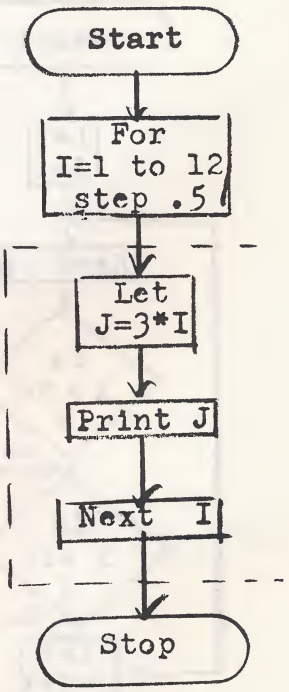
```
30 READ I,F,K
40 FOR J=I TO F STEP K
```

11. a. Missing line number.
    b. A number must appear after STEP not ONE.
    c. The index cannot be changed within the loop.
    d. A branch from outside a For-Next loop to inside the loop must not be made.

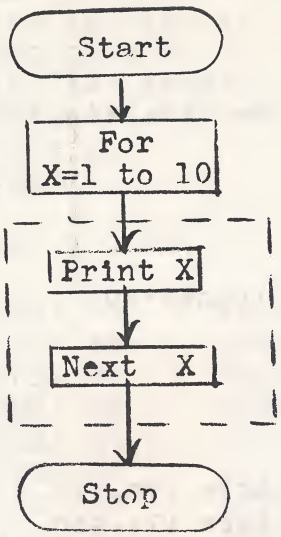
12. a.



b.



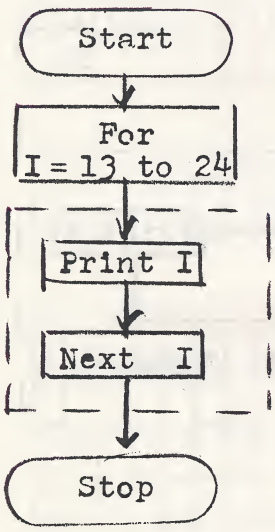
c.



13. a.
```
20 LET X=5
30 FOR N=1 TO 5
40 PRINT X
50 NEXT N
60 END
```
b.
```
20 FOR I=1 TO 7 STEP 3
30 LET I2=I↑2
40 PRINT I2
50 NEXT I
60 END
```

14. a. The following values will be printed: 2, 4, 6, 8, 10.
b. The following values will be printed: 3, 3.5, 4, 4.5.

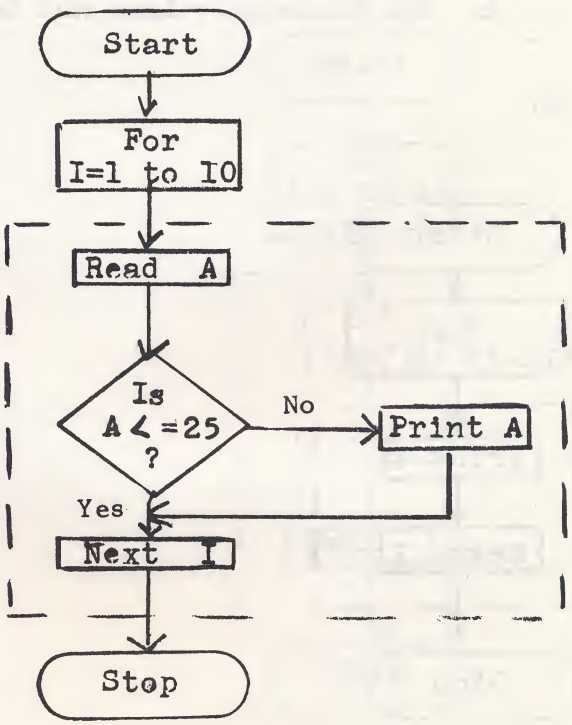
15.




```
10 REM PROBLEM 15, SET 5
20 FOR I= 13 TO 24
30 PRINT I
40 NEXT I
50 END

RUN

 13
 14
 15
 16
 17
 18
 19
 20
 21
 22
 23
 24
```

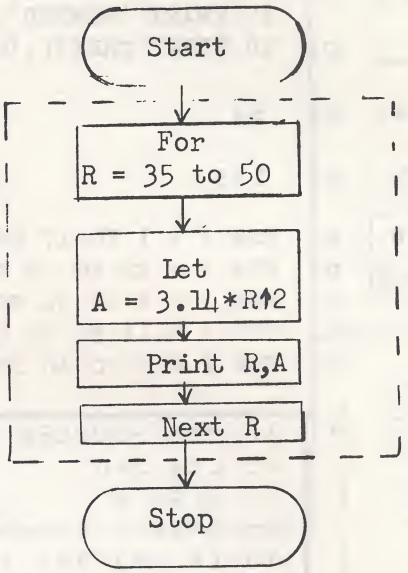
16.
```
10 REM PROELEM 16, SET 5
20 FOR I=1 TO 4
30 READ H,R
40  DATA 45, 3.75, 43.5, 3.8, 38, 3.6, 46, 4.05
50 IF H>40 THEN 80
60 LET W=H*R
70 GO TO 100
80 LET V=H-40
90 LET W=40 *R+V*1.5*R
100 PRINT 'HOURS=';H,'RATE=';R,'WAGE=';W
110 NEXT I
120 END

RUN

HOURS=  45        RATE=  3.75      WAGE=  178.125
HOURS=  43.5      RATE=  3.8       WAGE=  171.950
HOURS=  38        RATE=  3.6       WAGE=  136.80
HOURS=  46        RATE=  4.05      WAGE=  198.450
```

17.
```
10 REM PROELEM 17, SET 5
20 FOR I=1 TO 10
30 READ A
40 DATA 23.4, -876, 24.9, 35.2, 25.1, 103.2
41 DATA 10, 99.9, 25, -25
50 IF A<=25 THEN 70
60 PRINT A
70 NEXT I
80 END

RUN

 35.2
 25.1
 103.2
 99.9
```



18.

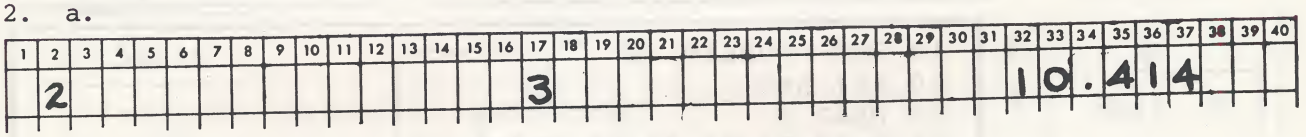
```
10 REM PROBLEM 18 SET 5
20 FOR R=35 TO 50
30 LET A=3.14*R↑2
40 PRINT 'RADIUS=':R,'AREA=':A
50 NEXT R
60 END

>>RUN

RADIUS=  35        AREA=  3846.50
RADIUS=  36        AREA=  4069.44
RADIUS=  37        AREA=  4298.66
RADIUS=  38        AREA=  4534.16
RADIUS=  39        AREA=  4775.94
RADIUS=  40        AREA=  5024.00
RADIUS=  41        AREA=  5278.34
RADIUS=  42        AREA=  5538.96
RADIUS=  43        AREA=  5805.86
RADIUS=  44        AREA=  6079.04
RADIUS=  45        AREA=  6358.50
RADIUS=  46        AREA=  6644.24
RADIUS=  47        AREA=  6936.26
RADIUS=  48        AREA=  7234.56
RADIUS=  49        AREA=  7539.14
RADIUS=  50        AREA=  7850.00
```



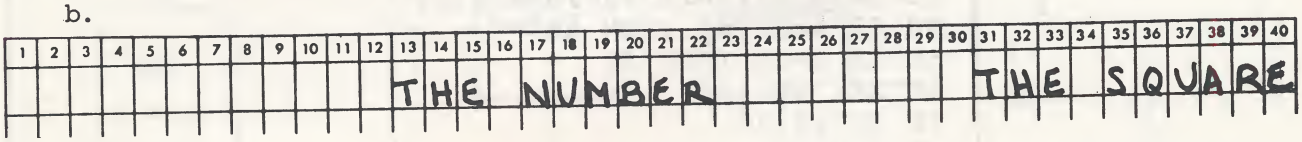
ANSWERS TO PROBLEM SET 6

1. a. Two quote marks,'', missing.
   b. One quote mark,', missing after the word PRINT.
   c. Left parenthesis missing,(, before the number 33.
   d. One quote mark,', missing before the word NO.

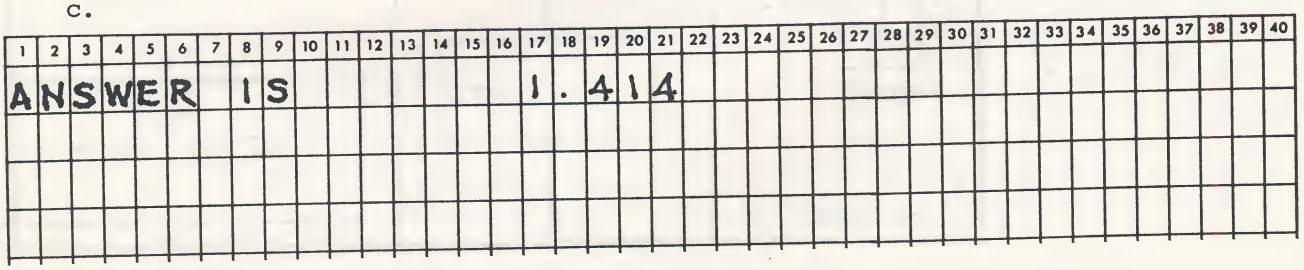
2. a.



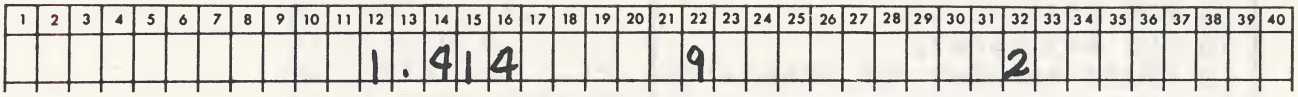
b.



c.



d.



3. a. 10 PRINT 'NUMBER','SQUARE','CUBE' or
10 PRINT 'NUMBER'; TAB(15);'SQUARE';TAB(30);'CUBE'
b. 10 PRINT TAB(5);'NUMBER';TAB(15);'SQUARE';TAB(25);'CUBE'

4. a. 51 b. 6 c. 404.5

5. a. 125 b. 72

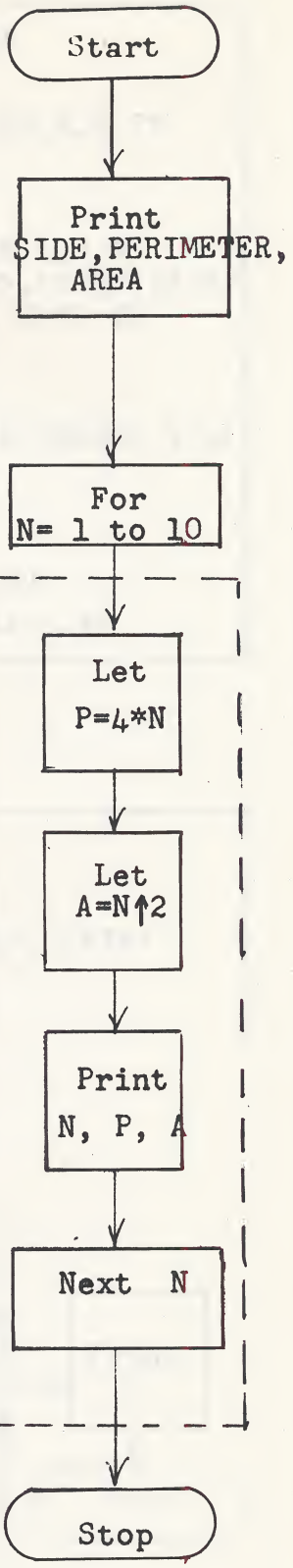
6. a. FOR I = 1 TO 17 STEP 4
b. FOR I = 28 TO 78 STEP 10
c. FOR I = 6 TO 36 STEP 6
d. FOR I = 11 TO 99 STEP 11
e. FOR I = 5 TO 40 STEP 5

7. a.
```
10 REM PROBLEM 7A
20 LET S=0
30 READ A
35 DATA 23,24,25,26,27,32767
40 IF A=32767 THEN 70
50 LET S=S+A
60 GO TO 30
70 PRINT S
80 END

>>RUN


 125
```

b.
```
10 REM PROBLEM 7B
20 LET S=0
30 READ A
35 DATA 23,24,25,26,27,32767
40 IF A=32767 THEN 80
50 IF A>25 THEN 30
60 LET S=S+A
70 GO TO 30
80 PRINT S
90 END

>>RUN


 72
```

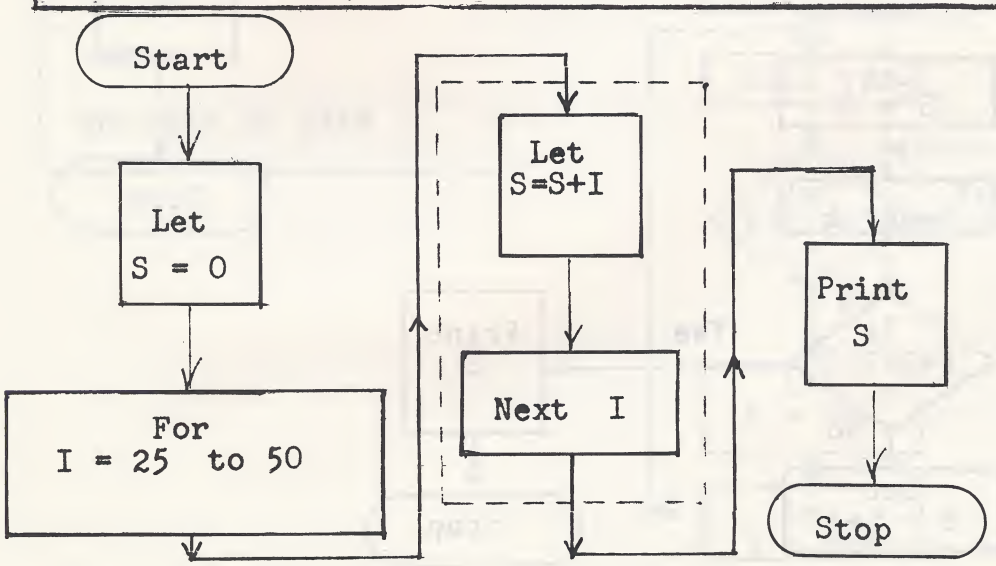
8.

```
10 REM PROBLEM 8
20 PRINT 'SIDE';TAB(15);'PERIMETER';TAB(30);'AREA'
30 FOR N=1 TO 10
40 LET P=4*N
50 LET A=N↑2
60 PRINT N;TAB(17);P;TAB(30);A
70 NEXT N
80 END

>>RUN

SIDE            PERIMETER       AREA
 1               4               1
 2               8               4
 3               12              9
 4               16              16
 5               20              25
 6               24              36
 7               28              49
 8               32              64
 9               36              81
 10              40              100
```



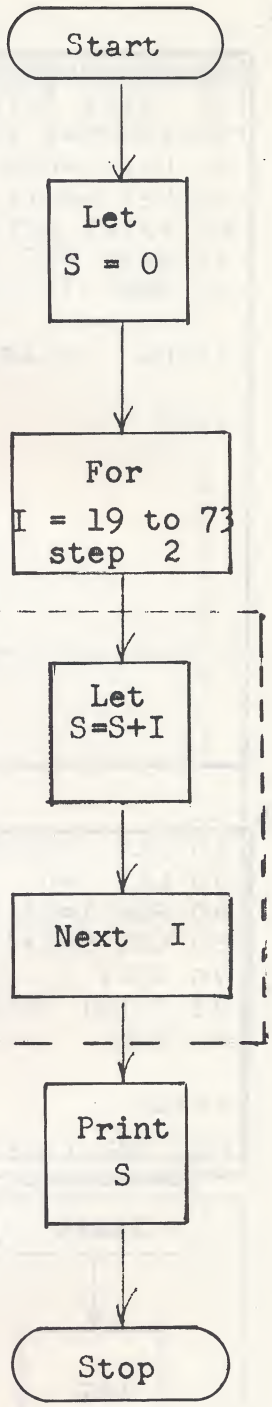
9. a.

```
10 REM PROBLEM 9A
30 LET S=0
40 FOR I=25 TO 50
50 LET S=S+I
70 NEXT I
75 PRINT 'FOR THE INTEGERS 25 TO 50 THE SUM IS';S
80 END

>>RUN
FOR THE INTEGERS 25 TO 50 THE SUM IS 975
```



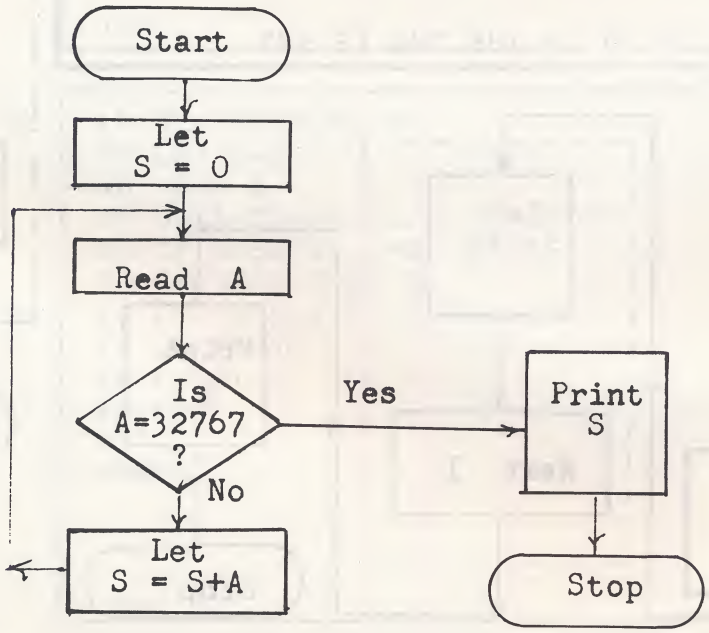
b.

```
10 REM PROB 9B
20 LET S=0
30 FOR I=19 TO 73 STEP 2
40 LET S=S+I
50 NEXT I
60 PRINT 'THE SUM IS';S
70 END

>>RUN

THE SUM IS  1288
```

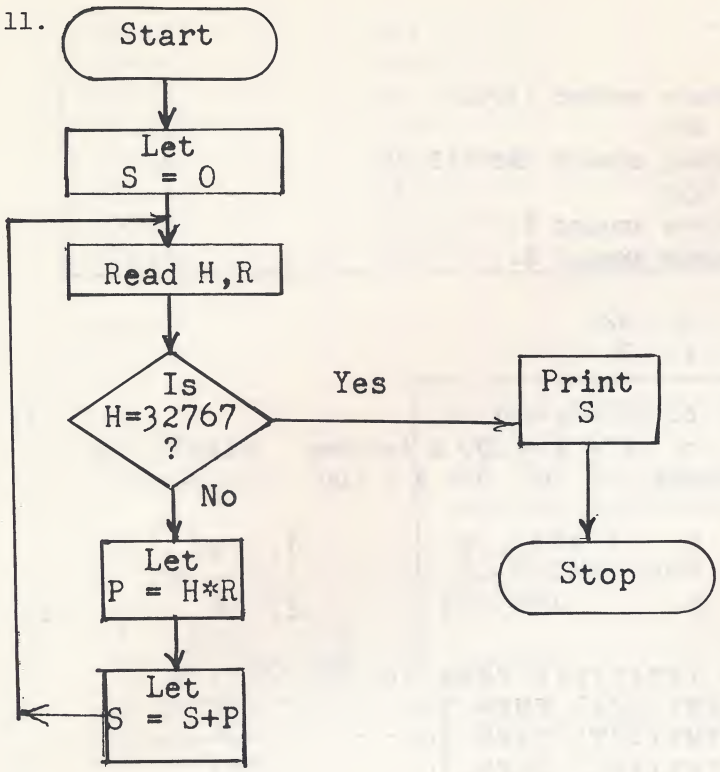


10.

```
10 REM PROB 10
20 LET S=0
30 READ A
35 DATA 56,34.8,79.3,269,57.2,32767
40 IF A=32767 THEN 70
50 LET S=S+A
60GO TO 30
70 PRINT 'SUM IS';S
80 END

>>RUN


SUM IS 496.3
```



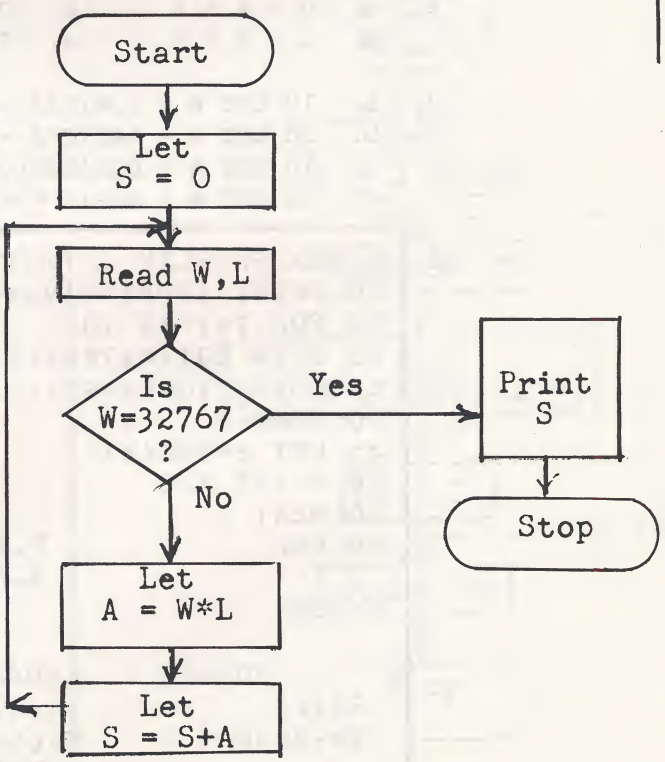
11.




```
10 REM PROB 11
20 LET S=0
30 READ H,R
35 DATA 10,9.50,8,8.75
36 DAA

36 DATA 7,9.25,6,7.95
37 DATA 4,9.75,32767,32767
40 IF H=32767 THEN 80
50 LET P=H*R
60 LET S=S+P
70 GO TO 30
80 PRINT 'LISA EARNED $';S
90 END

>>RUN

LISA EARNED $316.45
```

12.

```
10 REM PROBLEM 12
20 LET S=0
30 READ W,L
35 DATA 10, 12, 13, 25, 35, 70, 12, 18, 16, 28, 32767, 32767
40 IF W=32767 THEN 80
50 LET A=W*L
60 LET S=S+A
70 GO TO 30
80 PRINT 'THEAAREA IS' ;S
90 END

>>RUN

THE AREA IS 3559
```



ANSWERS TO PROBLEM SET 7

1. a. Missing parentheses around 13.7.
   b. Misspelled word RND.
   c. Missing parentheses around ABS(-11.7).
   d. Misspelled word SQR.
   e. Missing parentheses around 5.
   f. Missing parentheses around A.

2. a. 13 b. 2 c. 42
   d. 9 e. -24 f. 3

3. a. 0 < X < 5 b. 0 < X < 1
   c. 2 < X < 12 d. 1 < X < 20, X integer
   e. 0 < X < 2, X integer f. 0 < X < 100

4. a. 1 b. 1 c. 1 d. 9

5. a. 3 b. 6 c. 2 d. 5 e. -11

6. a. 40 IF 7/11 = INT(7/11) THEN 70
   b. 40 IF B/A = INT(B/A) THEN 70
   c. 40 IF 3/X = INT(3/X) THEN 70
   d. 40 IF X/Y = INT(X/Y) THEN 70

7. a. 20 LET X = INT(14 * RND(0))
   b. 20 LET X = INT(50 * RND(0) + 1)
   c. 20 LET X = INT(23 * RND(0) + 2)
   d. 20 LET X = INT(34 * RND(0) + 7)

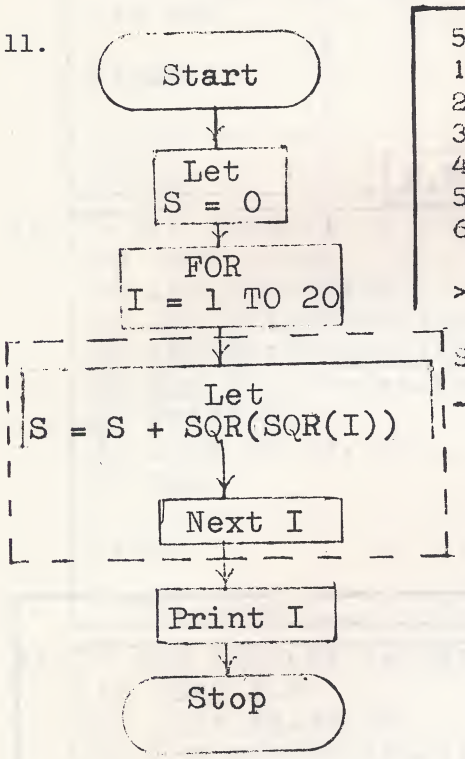
8. a. 0 < A < 1 b. 0 < A < 3 c. 0 < A < 10, A integer
   d. 1 < A < 5 e. 5 ≤ A ≤ 54, A integer f. 1 < A < 101

9. a. 10 LET R = SQR(A/3.14)
   b. 10 LET A = ABS(C↑2 - B↑2)
   c. 10 LET A = SQR(ABS(C↑2 - B↑2))
   d. 10 LET M = SQR(3 * K)

10.
```
5 REM PROBLEM 10 SET 7
10 PRINT TAB(6);'NUMBER';TAB(16);'SQUARE ROOT'
20 FOR I=1 TO 10
25 DATA 231.4,74.9,934.6,576.9,717.3,87.4
26 DATA 310.2,998.1,300.2,678.4
30 READ X
35 LET S=SQR(X)
40 PRINT X,S
50 NEXT I
60 END

>>RUN

      NUMBER        SQUARE ROOT
 231.4              15.211837
 74.900001          8.6544786
```

```
934.6           30.571228
576.9           24.018743
717.3           26.782457
87.400001       9.3487967
310.2           17.612495
998.1           31.592721
300.2           17.326281
678.4           26.046113
```

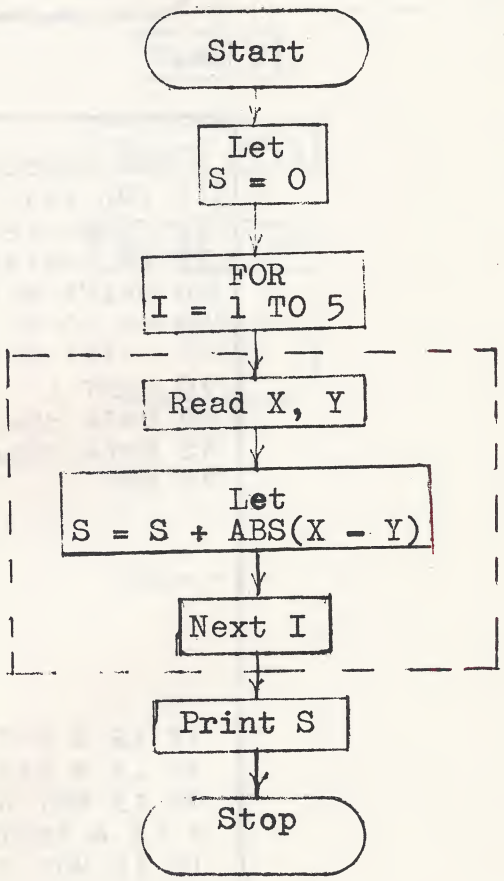
11.



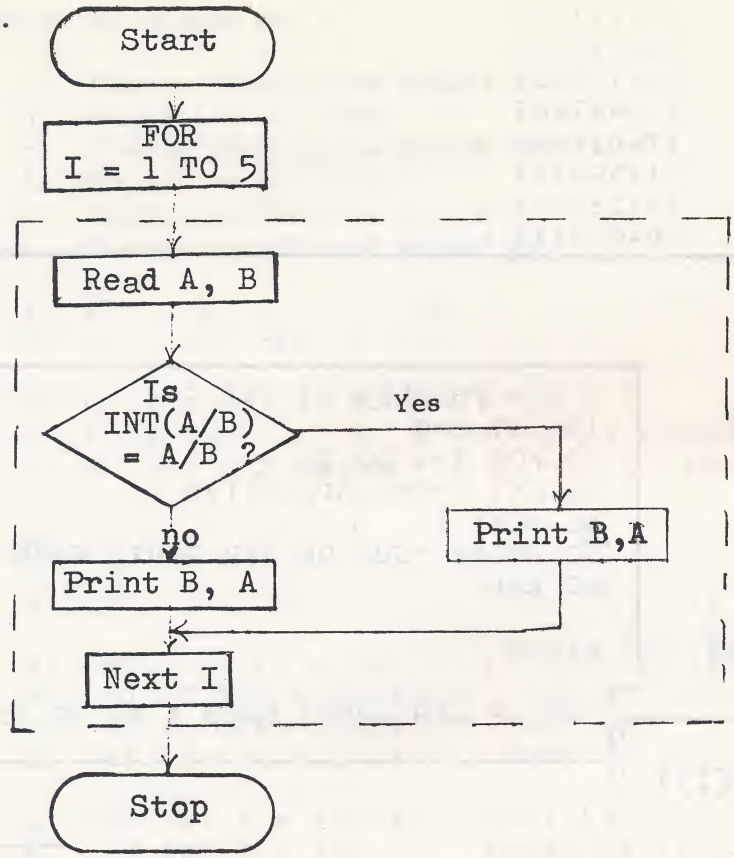

```
5 REM PROBLEM 11 SET 7
10 LET S=0
20 FOR I=1 TO 20
30 LET S=S+SQR(SQR(I))
40 NEXT I
50 PRINT 'SUM OF 4TH ROOTS FROM 1 TO 20 IS';S
60 END

>>RUN

SUM OF 4TH ROOTS FROM 1 TO 20 IS 34.575001
```

12.

```
5 REM PROBLEM 12,SET 7
10 LET S=0
20 FOR I=1 TO 5
30 READ X,Y
40 LET S=S+ABS(X-Y)
50 NEXT I
60 PRINT S
70
70 DATA 93.4,76.5,87.6,91.7,96.7
75 DATA 99.9,76.4,63.8,83.7,88.2
80 END

RUN

 41.3
```



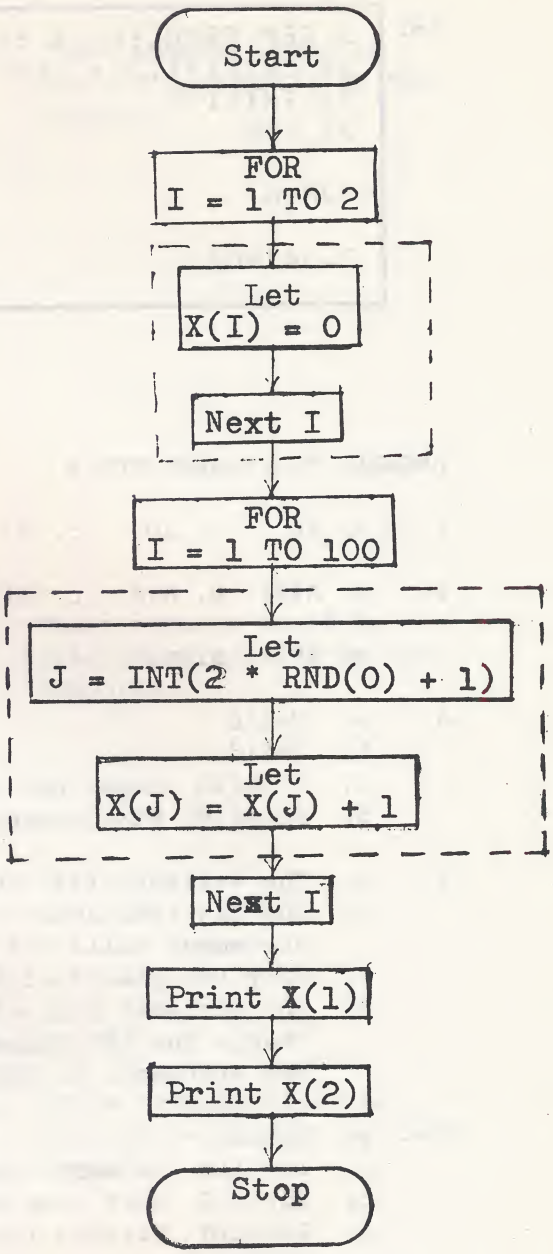
13.




```
5 REM PROBLEM 13 SET 7
10 FOR I=1 TO 5
20 READ A,B
30 IF INT(A/B)=A/B THEN 60
40 PRINT B;'IS NOT A FACTOR OF';A
50 GO TO 70
60 PRINT B;'IS A FACTOR OF';A
70 NEXT I
80 DATA 85,17,209,19,648,56
85 DATA 756,9,374,16
90 END

>>RUN


 17 IS A FACTOR OF 85
 19 IS A FACTOR OF 209
 56 IS NOT A FACTOR OF 648
 9 IS A FACTOR OF 756
 16 IS NOT A FACTOR OF 374
```

14.

```
5 REM PROBLEM 14 SET 7
10 DIM X(2)
20 FOR I=1 TO 2
30 LET X(I) = 0
40 NEXT I
50 FOR I=1 TO 100
60 LET J = INT(2*RND(0)+1)
70 LET X(J)=X(J)+1
80 NEXT I
90 PRINT 'NUMBER OF HEADS =';X(1)
100 PRINT 'NUMBER OF TAILS =';X(2)
110 END

>>RUN

NUMBER OF HEADS = 52
NUMBER OF TAILS = 48
```



15.

```
5 REM PROBLEM 15 SET 7
10 READ A,B,C
20 LET P=3.14159
30 LET X=TAN(A*P/180)
40 LET Y=TAN(B*P/180)
50 LET H = Y*(C*X/(Y-X))
60 PRINT H
70 DATA 12,38,1327
80 END

>>RUN

 387.48018
```

16.

```
5 REM PROBLEM 16 SET 7
10 READ X,A
20 DATA 56.34,72
30 LET B=3.1416*A/180
40 LET R=X/(2*SIN(B))
50 LET Y=R*COS(B/2)
60 PRINT Y
70 END

>>RUN

 23.962785
```

17.

```
5 REM PROBLEM 17 SET 7
10 READ I,P
20 LET M=(I-P)/(2.3*LOG(I/P))
30 PRINT M
40 DATA 3.57,2.4
50 END

>>RUN

 1.2810367
```

18.

```
5 REM PROBLEM 18 SET 7
10 LET X=1.2 + LOG(75)/LOG(43)
20 PRINT X
30 END

>>RUN

2.347902
```

ANSWERS TO PROBLEM SET 8

1. a. 16 b. 10 c. 9 d. 19 e. 45 f. 3 g. 30 h. 21

2. a. A(7) b. A(8) c. A(1) d. A(5) e. A(6) f. A(2) g. A(3) h. A(4)

3. a. 35 b. 43 c. 3 d. 26 e. 7 f. 300

4. a. Valid
   b. Valid
   c. Invalid Comma not permitted.
   d. Invalid Parentheses missing.
   e. Invalid Decimals not permitted.
   f. Invalid No BASIC variable.
   g. Invalid No BASIC variable.
   h. Valid

5. a. The variable I(X) should be X(I).
   b. The DIM indicates only 10 values assigned to Y(I), the FOR statement calls for 20 values.
   c. Only two pieces of data are indicated in the DATA statement.
   d. The variable P(1) will be assigned two different values. Change the LET statement to assign P(0) the value 3 or the FOR statement to FOR I = 2 TO 5.

6. a. Valid
   b. Invalid No BASIC variable.
   c. Invalid Must have number in parentheses.
   d. Invalid Missing line number.
   e. Valid
   f. Invalid DIM spelled incorrectly.

7. a. 5 DIM M(4) b. 5 DIM L(9) c. 5 DIM Z(5) d. 5 DIM I(3)
   e. 5 DIM B(11)

8. a.
```
10 DIM S(3)
20 FOR I = 1 TO 3
30 READ S(I)
40 NEXT I
```
   b.
```
10 DIM I(11)
20 FOR L = 1 TO 11
30 READ I(L)
40 NEXT L
```

9. a. No PRINT statement - hence, nothing would be printed.
   b. 31 33 35 37 39 41
      These numbers would be printed vertically by the computer.
   c. 90

d. 6 5 4 3 ← Note: These numbers would be printed vertically by the computer.

10. a. 5 7 13
    b. 13 -2
    c. 5
    d. -2 9
    e. -2 9

11. a. 1 2 3 4 5 5
        4 3 2 1
    b. 1 2 2 3 3 4

12.
```
10 DIM X (1000)
20 FOR I = 1 TO 1000
30 READ X(I)
40 PRINT X(I)
50 NEXT I
```

13. 50 45 40 35 30
    25 20 15 10 5

Note: These numbers would be printed vertically by the computer.

14.
```
10 DIM X(30)
20 FOR I = 1 TO 30
30 READ X(I)
40 NEXT I
50 FOR K = 3 TO 30 STEP 3
60 PRINT X(K)
70 NEXT K
80 DATA 1, 2, 3, 2, 3, 4, 3, 4, 5, 4
90 DATA 5, 6, 5, 6, 7, 6, 7, 8, 7, 8
95 DATA 9, 8, 9, 10, 9, 10, 11, 10, 11, 12
```

15. 4 8 24

Note: These numbers would be printed vertically by the computer.

16.
```
10 DIM A(20)
20 READ A(1),A(2)
30 FOR I = 3 TO 19 STEP 2
40 LET A(I) = A(1)
50 NEXT I
60 FOR I = 4 TO 20 STEP 2
70 LET A(I) = A(2)
80 NEXT I
90 DATA 2.5, 7.1
```

17. a. This flow chart illustrates selecting and printing the numbers in a list which are greater than 50 or equal to 50.

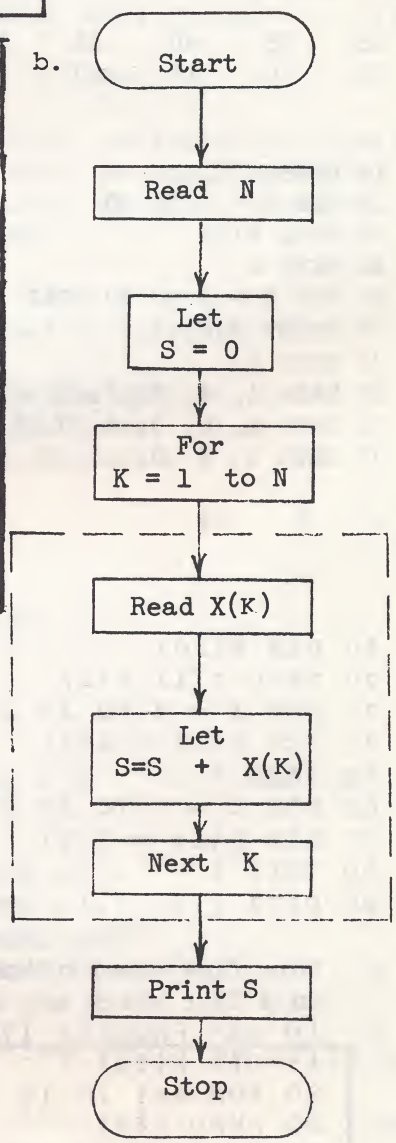
b.
```
10 REM PROBLEM 17B
15 DIM X(15)
20 FOR K=1 TO 15
30 READ X(K)
40 IF X(K)<50 THEN 60
```

```
50 PRINT X(K)
60 NEXT K
70 DATA 43,57,87,32,39
75 DATA 76,83,75,55,49
80 DATA 35,22,68,54,89
90 END

>>RUN

 57
 87
 76
 83
 75
 55
 68
 54
 89
```

18 a.

```
10 REM PROBLEM 18
15 DIM X(50)
20 READ N
25 LET S=0
30 FOR K= 1 TO N
35 READ X(K)
40 LET S = S + X(K)
45 NEXT K
50 PRINT S
60 DATA 9. 78.4.93.7.100.3
65 DATA 98.7.113.2.84.5
70 DATA 97.8.83.4.87.8
80 END

>>RUN

 837.8
```

b.



19.

```
10 REM PROBLEM 19
15 DIM C(10)
20 LET S=0
25 FOR K=1 TO 8
30 READ C(K)
35 LET R=.15*C(K)
40 LET S=S+R
50 NEXT K
60 LET A=S/8
70 PRINT 'AVERAGE REDUCTION IS';A
75 DATA 2143,1875,1492,1776
80 DATA 1975,3200,2550,2890
90 END

>>RUN

AVERAGE REDUCTION IS 335.64375
```

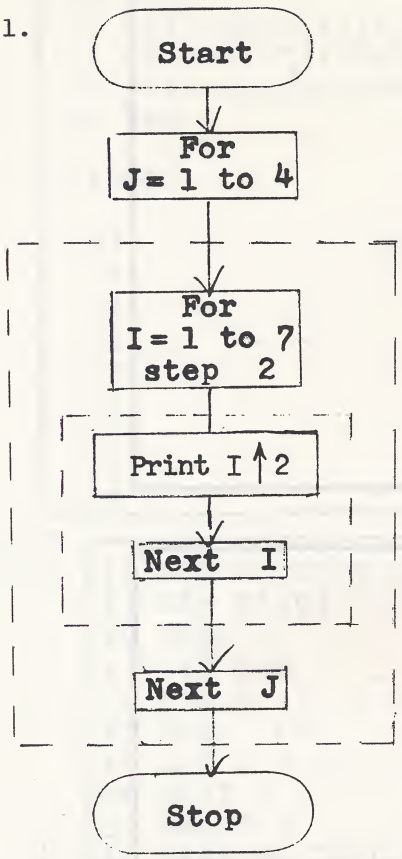
20.

```
5 DIM V(4)
10 REM PROBLEM 20
15 LET V(1)=0
16 LET V(2)=0
17 LET V(3)=0
18 LET V(4)=0
20 FOR K=1 TO 48
25 READ X
30 LET V(X)=V(X)+1
35 NEXT K
40 PRINT 'TOTAL VOTE FOR SNOOPY IS';V(1)
41 PRINT
50 PRINT 'TOTAL VOTE FOR DOONESBURY IS';V(2)
51 PRINT
60 PRINT 'TOTAL VOTE FOR POGO IS';V(3)
61 PRINT
70 PRINT 'TOTAL VOTE FOR KRAZY KAT IS';V(4)
75 DATA 2,4,4,3,1,1,4,1,2,2,2,1
80 DATA 3,4,3,4,1,4,4,1,1,2,1,3
85 DATA 1,1,3,4,4,2,3,4,3,4,1,2
90 DATA 4,3,4,1,2,1,4,4,2,2,1,4
95 END

>>RUN

TOTAL VOTE FOR SNOOPY IS 14

TOTAL VOTE FOR DOONESBURY IS 10

TOTAL VOTE FOR POGO IS 8

TOTAL VOTE FOR KRAZY KAT IS 16
```

The most popular character was Krazy Kat.

ANSWERS TO PROBLEM SET 9

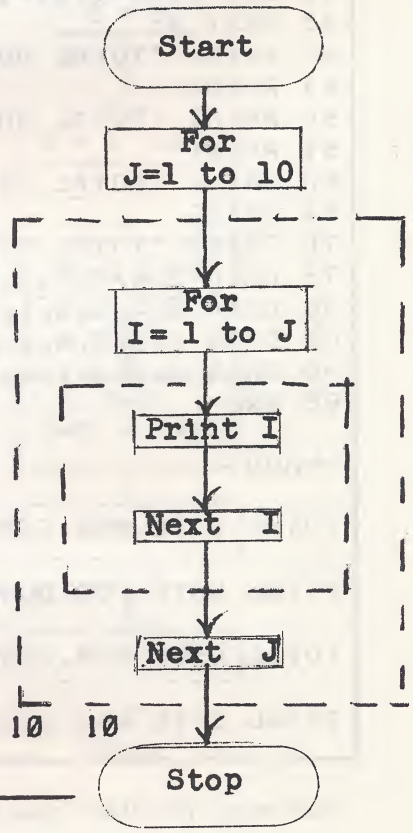
1.




```
10 REM PROBLEM 1, SET 9
20 FOR J=1 TO 4
30 FOR I=1 TO 7 STEP 2
40 PRINT I↑2;
50 NEXT I
60 PRINT
70 NEXT J
80 END

>>RUN


 1  9  25  49
 1  9  25  49
 1  9  25  49
 1  9  25  49
```

2.

```
10 REM PROBLEM 2, SET 9
20 FOR J=1 TO 10
30 FOR I=1 TO J
40 PRINT J;
50 NEXT I
60 PRINT
70 NEXT J
80 END

>>RUN


1
2  2
3  3  3
4  4  4  4
5  5  5  5  5
6  6  6  6  6  6
7  7  7  7  7  7  7
8  8  8  8  8  8  8  8
9  9  9  9  9  9  9  9  9
10  10  10  10  10  10  10  10  10  10
```



3. a. 3 4
   b. 5 8
   c. 1 8
   d. 3 1

4. a. 5
   b. 9
   c. 10
   d. 5

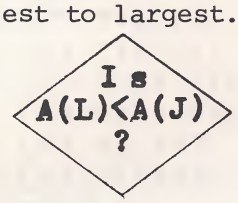
5. a.
```
50 LET T=X
60 LET X=Y
70 LET Y=T
```

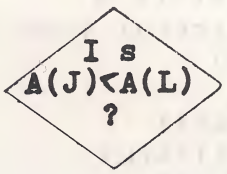
   b.
```
50 LET T=A(I)
60 LET A(I)=M(L)
70 LET M(L)=T
```

   c.
```
50 LET T=M(1)
60 LET M(1)=M(10)
70 LET M(10)=T
```

6. a. largest
   b. smallest
   c. largest
   d. smallest

7. a. 1 b. 1 c. 1
      2 2 2
      3 3 3
   d. Smallest to largest.

8. **CHANGE** 

TO 

9.
```
10 REM PROBLEM 9, SET 9
20 DIM A(100)
30 READ N
40 FOR I=1 TO N
50 READ A(I)
60 NEXT I
70 FOR I=1 TO N-1
80 LET L=I
90 FOR J=I+1 TO N
100 IF A(J)<A(L) THEN 120
110 LET L=J
120 NEXT J
130 LET T=A(I)
```

```
140 LET A(I)=A(L)
150 LET A(L)=T
160 NEXT I
170 FOR K=1 TO N
180 PRINT A(K)
190 NEXT K
200 DATA...
201 DATA...
210 END
```

10. a.
```
10 REM PROBLEM 9, SET 9
20 DIM A(100)
30 READ N
40 FOR I=1 TO N
50 READ A(I)
60 NEXT I
70 FOR I=1 TO N-1
80 LET L=I
90 FOR J=I+1 TO N
100 IF A(L)<A(J) THEN 120
110 LET L=J
120 NEXT J
130 LET T=A(I)
140 LET A(I)=A(L)
150 LET A(L)=T
160 NEXT I
170 FOR K=1 TO N
180 PRINT A(K);
190 NEXT K
200 DATA 4
201 DATA 137.2,58.1,66.8,193.4
210 END

>>RUN

 58.1  66.8  137.2  193.4
```

b.
```
200 DATA 3
201 DATA -143,-213,-556.5

>>RUN

-556.5 -213 -143
```

c.
```
200 DATA 10
201 DATA 45,98,77,13,73,-89,-67,0,44,39

>>RUN


-89   0   13   39   44   45   -67   73   77   98
```

11.
```
10 REM PROBLEM 11   SET 9
20 DIM A(100),N(100)
25 PRINT 'NUMBER','HOURS WORKED'
30 READ N
40 FOR I=1 TO N
50 READ N(I),A(I)
60 NEXT I
70 FOR I=1 TO N-1
80 LET L=I
90 FOR J=I+1 TO N
100 IF A(L)>A(J) THEN 120
110 LET L=J
120 NEXT J
130 LET T=A(I)
135 LET T1=N(I)
140 LET A(I)=A(L)
145 LET N(I)=N(L)
150 LET A(L)=T
155 LET N(L)=T1
160 NEXT I
170 FOR K=1 TO N
180 PRINT N(K),A(K)
190 NEXT K
200 DATA 5
201 DATA 756,37.5
202 DATA 1249,42.75
203 DATA 800,41.5
204 DATA 1680,18.25
205 DATA 1520,40.75
210 END

>>RUN


NUMBER          HOURS WORKED
 1249            42.75
 800             41.5
 1520            40.75
 756             37.5
 1680            18.25
```

ANSWERS TO PROBLEM SET 10

1. The variables found in parts b, c, d, and f are string variables, as indicated by the symbol $.

2. a. K$
   b. Q6$
   c. L2$
   d. V3$

3. a.

```
NAME                WAGE                POSITION
JONES               175                 FIREMAN
```

b.

```
NAME                WAGE                POSITION
WICKS               300                 SECURITY
```

c.

```
NAME                WAGE                POSITION
SYSZKI              456                 FOREMAN
```

4. a.

```
10 REM PROBLEM 4A
20 INPUT A$,B$
30 PRINT A$;TAB(5);A$;TAB(10);'QUITE CON
40 PRINT A$;TAB(5);'HAD A LITTLE ';B$
50 PRINT A$;TAB(4);'LAND WAS A COLONY'
60 END

TRARY'
```

b.

```
10 REM PROB 4B
20 INPUT C$,D$
30 PRINT C$;TAB(4);'FOR';TAB(8);D$;TAB(1
40 PRINT D$;TAB(4); 'FOR';C$
50 END

2);'AND'
```

5. a.
```
20 READ D$,A,B
```
b.
```
30 READ X,V$,Y
```
c.
```
40 READ R,S$,T$,Q
```

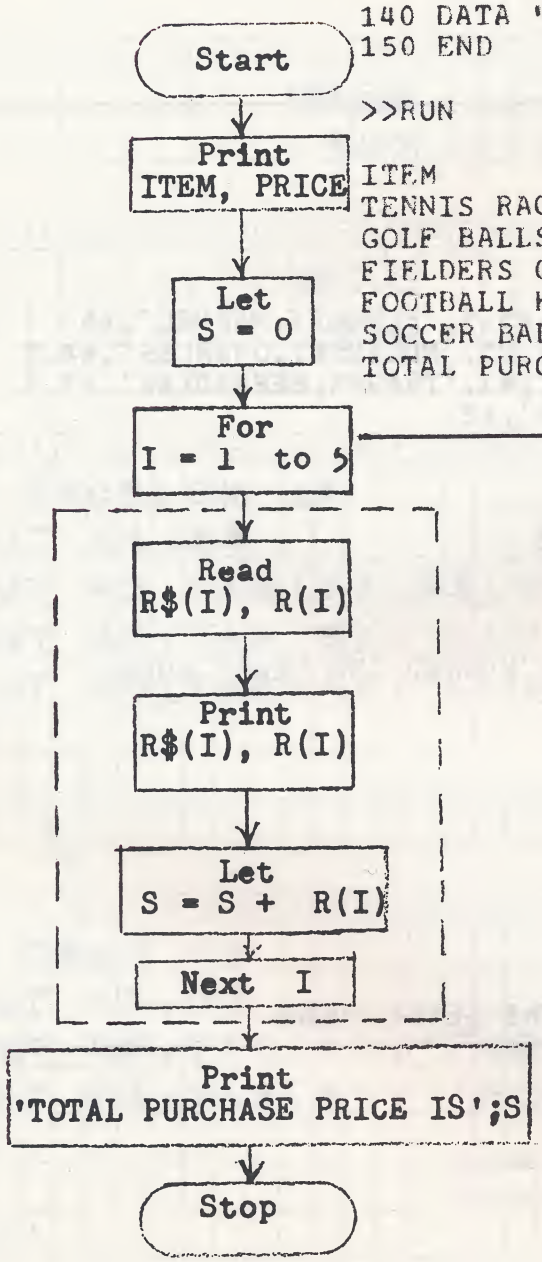
6. a.
```
10 READ A,B$,C,D
20 DATA 4792,'ZEPPELIN',1259.99,3
```
b.
```
30 READ E,F$,G,H
40 DATA 1010,'NORA ARON',37.5,9.95
```
c.
```
50 READ J$,K,L,M,N
60 DATA 'OCTOBER',12,2001,6543,550.12
```
d.
```
70 READ P,R$,T$,X
80 DATA 1205,'MONDAY','AZUZA',1237
```

7.
```
5 REM PROBLEM 7
10 DIM R$(7),R(7)
20 READ N
25 DATA 7
30 FOR K=1 TO N
40 READ R$(K),R(K)
45 DATA 'BROUNDEL,JOHN',45.5,'ELSONTE,MARVEL',43
46 DATA 'HOWARD,ELSIE',42.25,'MOLEWSKI,CHARLES',44.5
47 DATA 'PRESSMAN,MOSHE',41,'TRAGER,BERNADINE',43.5
48 DATA 'WEMBLETON,AGNES',42
60 NEXT K
70 LET S=1
80 FOR I=2 TO N
90 IF R(S)>R(I) THEN 100
95 GO TO 110
100 LET S=I
110 NEXT I
120 PRINT R$(S);TAB(16);'WORKED THE LEAST HOURS'
130 END


>>RUN

PRESSMAN,MOSHE  WORKED THE LEAST HOURS
```

8. a. The letter A is assigned to G$(3).
b. The letter T is assigned to G$(8).
c. The computer would print
STAT

9.

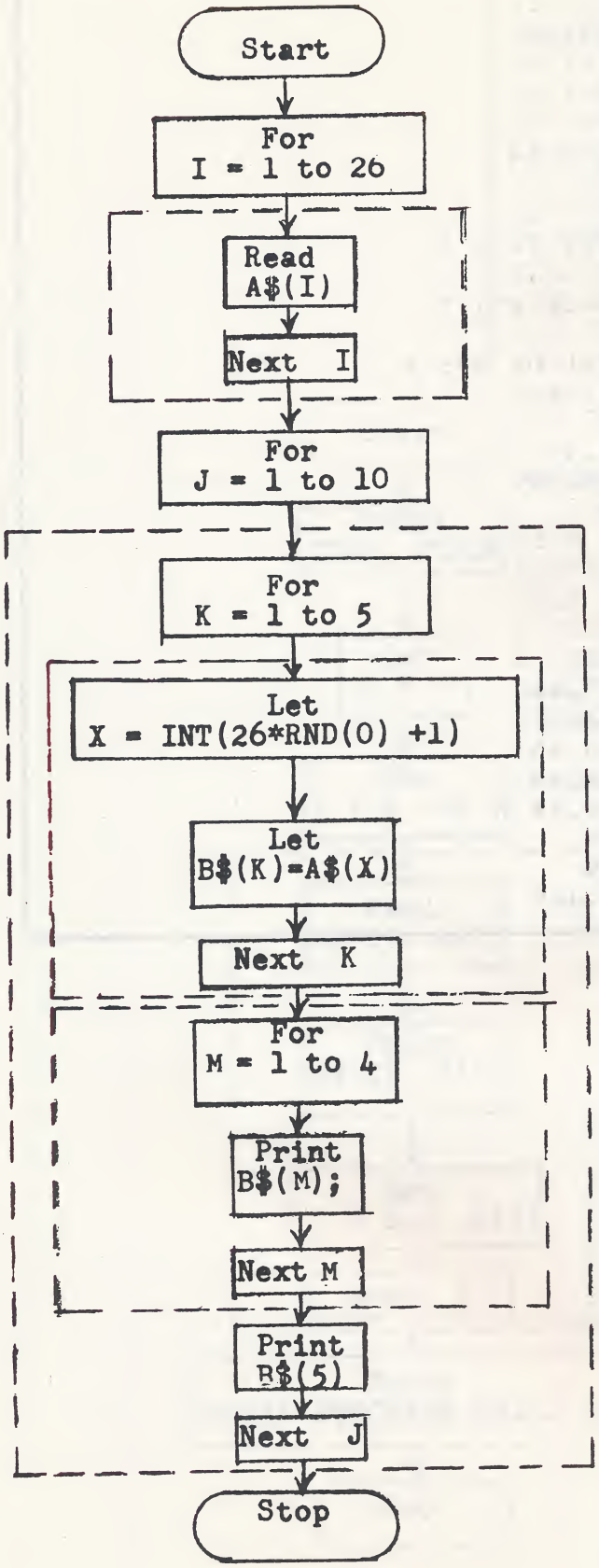
```
10 REM PROBLEM 9
15 DIM R(5),R$(5)
20 PRINT "ITEM"; TAB(25);"PRICE"
30 LET S = 0
40 FOR I = 1 TO 5
50 READ R$(I), R(I)
60 PRINT R$(I); TAB(25);"$"; R(I)
70 LET S = S + R(I)
80 NEXT I
90 PRINT "TOTAL PURCHASE PRICE IS"; S
100 DATA "TENNIS RACQUET",17.46
110 DATA "GOLF BALLS",28.50
120 DATA "FIELDERS GLOVE",16.95
130 DATA "FOOTBALL HELMET",19.99
140 DATA "SOCCER BALL",10.88
150 END

>>RUN

ITEM                          PRICE
TENNIS RACQUET                $ 17.46
GOLF BALLS                    $ 28.5
FIELDERS GLOVE                $ 16.95
FOOTBALL HELMET               $ 19.99
SOCCER BALL                   $ 10.88
TOTAL PURCHASE PRICE IS 93.78
```



10.

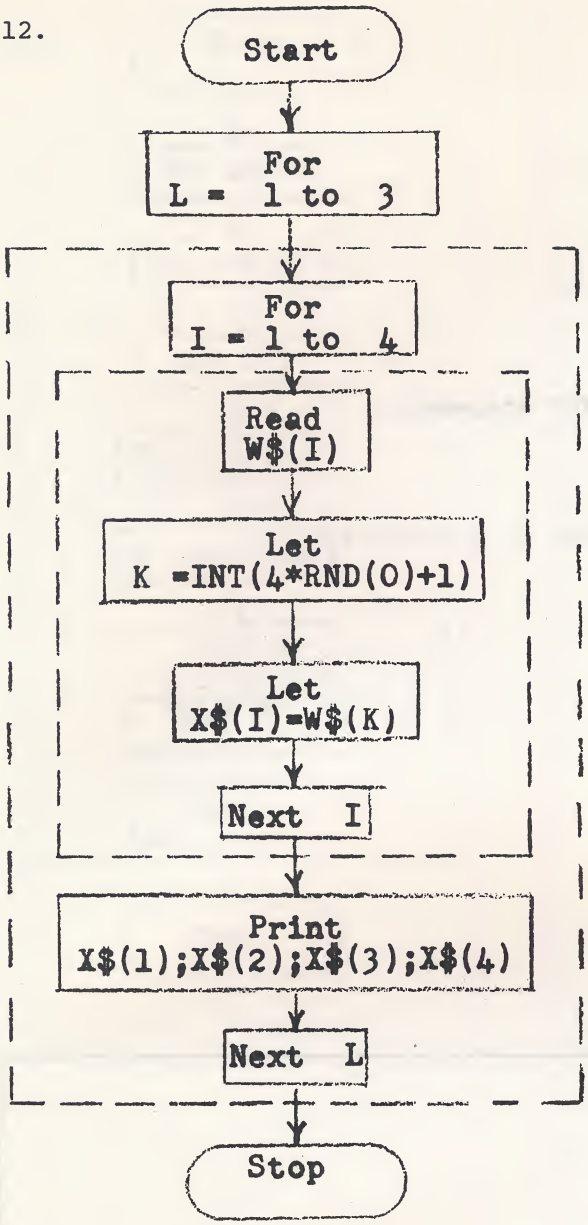
```
10 REM PROBLEM 10
15 DIM R(5),R$(5)
20 PRINT "ITEM"; TAB(25):"PRICE"
30 LET S = 0
40 FOR I = 1 TO 5
50 READ R$(I), R(I)
60 PRINT R$(I); TAB(25);"$"; R(I)
70 LET S = S + R(I)
80 NEXT I
90 PRINT "TOTAL PURCHASE PRICE IS"; S
91 LET T = .05*S
92 PRINT "MELODIE PAYS A TAX OF $"; T
93 LET A = S + T
94 PRINT "MELODIE PAYS A TOTAL OF $"; A
100 DATA "TENNIS RACQUET",17.46
110 DATA "GOLF BALLS",28.50
120 DATA "FIELDERS GLOVE",16.95
130 DATA "FOOTBALL HELMET",19.99
140 DATA "SOCCER BALL",10.88
150 END

>>RUN

ITEM                          PRICE
TENNIS RACQUET                $ 17.46
GOLF BALLS                    $ 28.5
FIELDERS GLOVE                $ 16.95
FOOTBALL HELMET               $ 19.99
SOCCER BALL                   $ 10.88
TOTAL PURCHASE PRICE IS 93.78
MELODIE PAYS A TAX OF $ 4.689
MELODIE PAYS A TOTAL OF $ 98.469
```

11.




```
10 REM PRØBLEM 11
15 DIM A$(26),B$(26)
20 FØR I = 1 TØ 26
30 READ A$(I)
32 DATA A,B,C,D,E,F,G,H,I,J,K,L,M
34 DATA N,Ø,P,Q,R,S,T,U,V,W,X,Y,Z
40 NEXT I
50 FØR J = 1 TØ 10
60 FØR K = 1 TØ 5
70 LET X = INT(26*RND(0) + 1)
80 LET B$(K) = A$(X)
90 NEXT K
100 FØR M = 1 TØ 4
110 PRINT B$(M);
120 NEXT M
130 PRINT B$(5)
140 NEXT J
150 END

>>RUN



ØKPYH
UUAFZ
HJYEM
KNIIF
DNFGQ
UKNDB
PNIFG
GIHØB
TPNMK
IHLMQ
```

12.




```
10 REM PROBLEM 12
15 DIM W$(4),X$(4)
20 FOR I=1 TO 4
30 READ W$(I)
40 NEXT I
50 FOR L=1 TO 3
60 FOR I=1 TO 4
70 DATA "HOW","NOW","BROWN","COW"
80 LET K= INT(4*RND(0) + 1)
90 LET X$(I) = W$(K)
100 NEXT I
110 PRINT X$(1);X$(2);X$(3);X$(4)
120 NEXT L
130 END

>>RUN

BROWNBROWNHOWNOW
BROWNHOWBROWNBROWN
BROWNCOWHOWBROWN
```

ANSWERS TO PROBLEM SET 11

1. a. -3 d. 3.3
   b. 2 e. -4
   c. 2 f. 4.6

2. 10 DIM R(3,4)

3. a. D(2,1) d. D(4,1)
   b. D(1,3) e. D(3,4)
   c. D(4,4) f. D(3,2)

4. 10 DIM D(4,5)

5. a. 2 c. 3
   b. 9 d. 5

6. a. 10 DIM J(8,4)
   b. 10 DIM G(10,10)
   c. 10 DIM K(14), D(8,9)
   d. 10 DIM R(6,4), Q(6,4)

7. a. Missing array name.
   b. No DIMensioning in a PRINT statement.
   c. DIM misspelled.
   d. PRINT after MAT.
   e. Missing array name.
   f. Missing column designation in parenthesis.

8. X(1,1)=2 X(2,1)=8
   X(1,2)=4 X(2,2)=10
   X(1,3)=6 X(2,3)=12

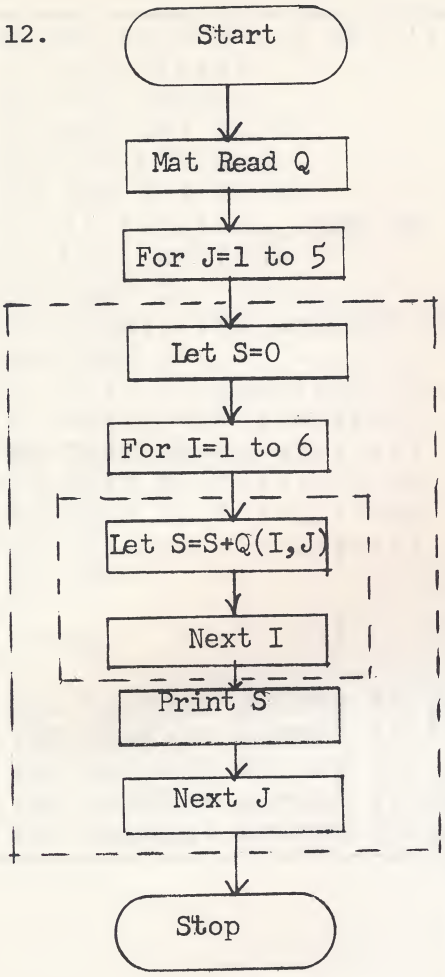
9. a. 10 MAT READ C(3,5)
   b. 10 MAT READ T(13,25)

10. a. 154
    b. 14

11.

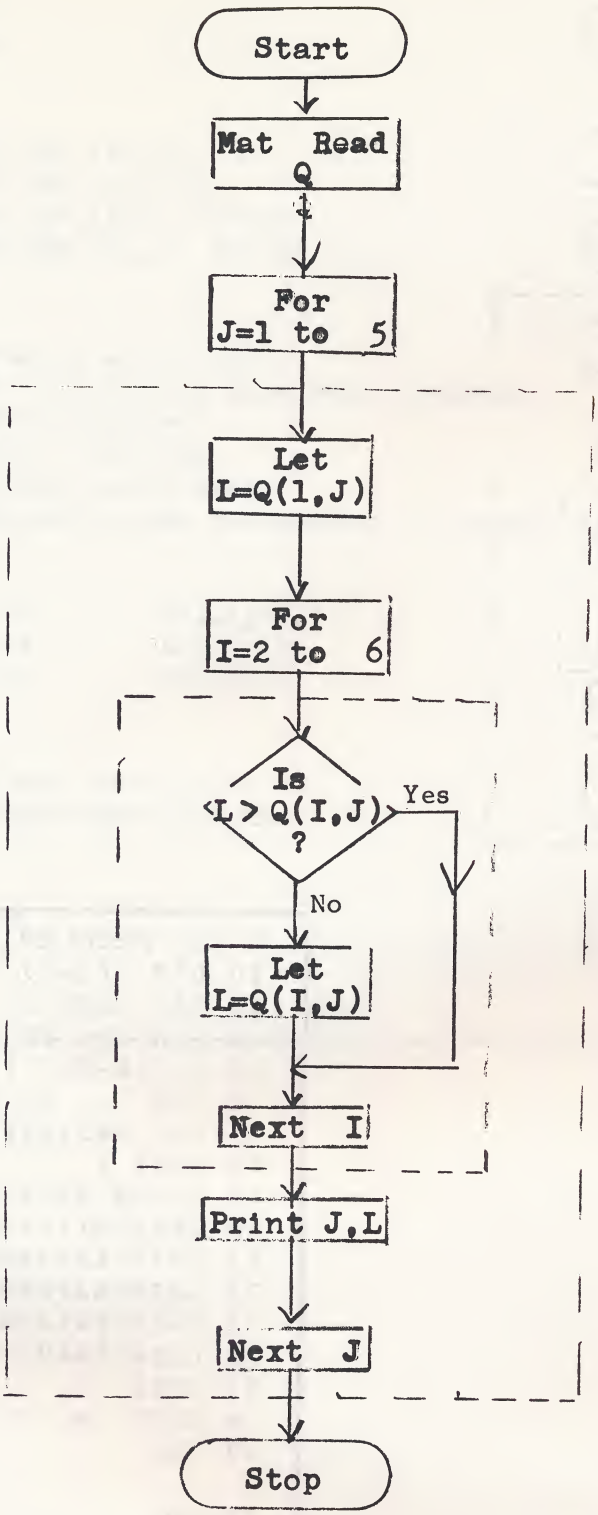
```
5 REM PROBLEM 11 SET 11
10 DIM Q(6,5)
20 MAT READ Q
30 MAT PRINT Q
91 DATA 17,14,47,56,86
92 DATA 34,37,64,31,62
93 DATA 19,43,48,16,27,
94 DATA 24,92,34,99,44
95 DATA 82,33,75,17,52
96 DATA 64,77,83,24,67
97 END

>>RUN                                          NH


 17          14          47          56          86
 34          37          64          31          62
 19          43          48          16          27
 24          92          34          99          44
 82          33          75          17          52
 64          77          83          24          67
```

12.



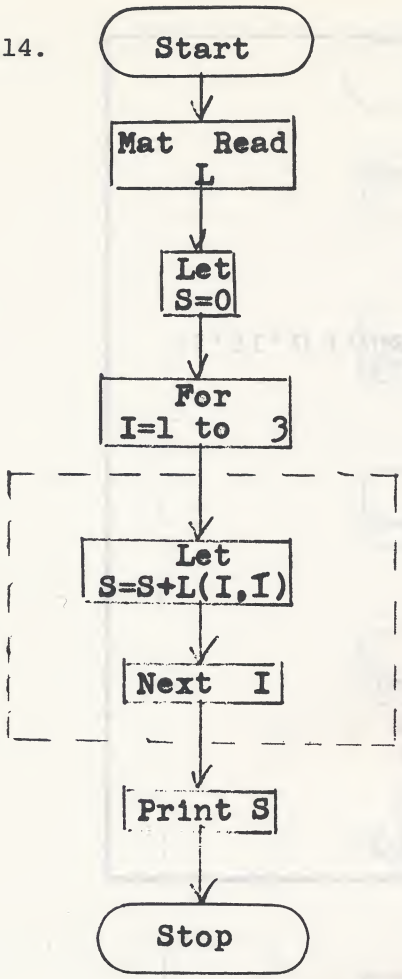

```
5 REM PROBLEM 12 SET 11
10 DIM Q(6,5)
15 MAT READ Q
20 FOR J=1 TO 5
25 LET S=0
30 FOR I=1 TO 6
35 LET S=S+Q(I,J)
40 NEXT I
45 PRINT S
50 NEXT J
91 DATA 17,14,47,56,86
92 DATA 34,37,64,31,62
93 DATA 19,43,48,16,27,
94 DATA 24,92,34,99,44
95 DATA 82,33,75,17,52
96 DATA 64,77,83,24,67
97 END

>>RUN

 240
 296
 351
 243
 338
```

13.


Start
Mat Read Q
For J=1 to 5
Let L=Q(1,J)
For I=2 to 6
Is <L> Q(I,J) ?
Yes
No
Let L=Q(I,J)
Next I
Print J,L
Next J
Stop

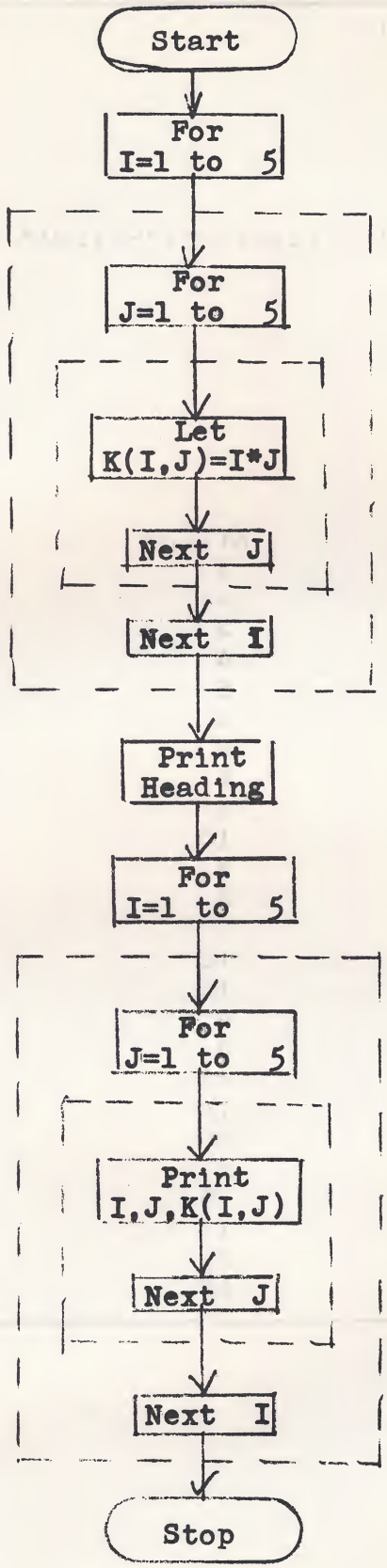
```
5 REM PROBLEM 13 SET 11
10 DIM Q(6,5)
20 MAT READ Q
25 FOR J=1 TO 5
30 LET L=Q(1,J)
35 FOR I=2 TO 6
40 IF L>Q(I,J) THEN 50
45 LET L=Q(I,J)
50 NEXT I
55 PRINT 'THE LARGEST NUMBER IN COLUMN';J;'IS';L
60 NEXT J
91 DATA 17,14,47,56,86
92 DATA 34,37,64,31,62
93 DATA 19,43,48,16,27
94 DATA 24,92,34,99,44
95 DATA 82,33,75,17,52
96 DATA 64,77,83,24,67
97 END

>>RUN

THE LARGEST NUMBER IN COLUMN 1 IS 82
THE LARGEST NUMBER IN COLUMN 2 IS 92
THE LARGEST NUMBER IN COLUMN 3 IS 83
THE LARGEST NUMBER IN COLUMN 4 IS 99
THE LARGEST NUMBER IN COLUMN 5 IS 86
```

14.




```
5 REM PROBLEM 14 SET 11
10 DIM L(3,3)
20 MAT READ L
25 DATA 6,9,0,-3,-4,5,12,6,17
30 LET S=0
35 FOR I=1 TO 3
40 LET S=S+L(I,I)
45 NEXT I
50 PRINT S
60 END

>>RUN

 19
```

15.


Start
For I=1 to 5
For J=1 to 5
Let K(I,J)=I*J
Next J
Next I
Print Heading
For I=1 to 5
For J=1 to 5
Print I,J,K(I,J)
Next J
Next I
Stop

```
5 REM PROBLEM 15 SET 11
10 DIM K(5,5)
20 FOR I=1 TO 5
30 FOR J=1 TO 5
40 LET K(I,J)=I*J
50 NEXT J
60 NEXT I
70 PRINT ' I';TAB(15);' J';TAB(30);'K(I,J)'
80 FOR I=1 TO 5
85 FOR J=1 TO 5
90 PRINT I,J,K(I,J)
95 NEXT J
100 NEXT I
110 END

>>RUN

 I             J             K(I,J)
 1             1              1
 1             2              2
 1             3              3
 1             4              4
 1             5              5
 2             1              2
 2             2              4
 2             3              6
 2             4              8
 2             5              10
 3             1              3
 3             2              6
 3             3              9
 3             4              12
 3             5              15
 4             1              4
 4             2              8
 4             3              12
 4             4              16
 4             5              20
 5             1              5
 5             2              10
 5             3              15
 5             4              20
 5             5              25
```

```
5 REM PROBLEM 16 SET 11
10 DIM N$(5),M$(3),X(5,3)
15 FOR I=1 TO 5
20 READ N$(I)
25 NEXT I
30 DATA 'SMITH','DVORAK','EVANS','JOHNSON','LUOYE'
35 FOR I=1 TO 3
40 READ M$(I)
45 NEXT I
46 MAT READ X
50 DATA 'MARCH','APRIL','MAY'
60 DATA 234,437,515,432,686,389,117,232
65 DATA 172,672,511,413,532,449,375
70 FOR I=1 TO 5
75 LET S=0
80 FOR J=1 TO 3
85 LET S=S+X(I,J)
90 NEXT J
95 LET A=S/3
98 PRINT 'AVERAGE FOR ';N$(I);' IS';A
100 NEXT I
110 FOR J=1 TO 3
115 LET S=0
120 FOR I=1 TO 5
125 LET S=S+X(I,J)
130 NEXT I
135 LET A=S/5
140 PRINT 'AVERAGE FOR MONTH OF ';M$(J);' IS';A
150 NEXT J
160 LET S=X(1,1)
165 LET L=X(1,1)
170 FOR I=1 TO 5
180 FOR J=1 TO 3
185 IF X(I,J)>=S THEN 200
190 LET S = X(I,J)
200 IF X(I,J)<=L THEN 210
205 LET L=X(I,J)
210 NEXT J
220 NEXT I
230 PRINT 'LARGEST COMMISSION IS';L
240 PRINT 'SMALLEST COMMISSION IS';S
250 END

>>RUN
AVERAGE FOR SMITH IS 395.33333
AVERAGE FOR DVORAK IS 502.33333
AVERAGE FOR EVANS IS 173.66667
AVERAGE FOR JOHNSON IS 532
AVERAGE FOR LUOYE IS 452
AVERAGE FOR MONTH OF MARCH IS 397.4
AVERAGE FOR MONTH OF APRIL IS 463
AVERAGE FOR MONTH OF MAY IS 372.8
LARGEST COMMISSION IS 686
SMALLEST COMMISSION IS 117
```

ANSWERS TO PROBLEM SET 12

1. a. Invalid Line number missing.
   b. Valid provided B was previously defined in the program.
   c. Invalid FN missing.
   d. Valid
   e. Valid provided C was previously defined in the program.

2. a. 16
   b. 81
   c. 32
   d. 1
   e. 97.5
   f. 228.01

3. a. 10 DEF FNC(X) = 3 * X↑2 - 12 * X + 7
   b. 10 DEF FNC(R,S,T) = (R + S - T) / 5
   c. 10 DEF FNC(X,Y,Z) = SQR(X * Y * Z)
   d. 10 DEF FNC(Y) = Y↑3 - 4 * Y↑2 + 3 * Y + 8
   e. 10 DEF FNC(X,Y) = (X↑2 + Y↑2) / (X↑2 - Y↑2)

4. a. T = 135
   b. T = 300
   c. T = 170

5. 10 DEF FNK(A,B) = SQR(A↑2 + B↑2)

6. a. 20 LET H = FNK(3,4)
   b. 20 LET H = FNK(5,12)
   c. 20 LET P = FNK(.8,.6)
   d. 20 LET Z = FNK(7,9)

7. a. Variable not permitted after GOSUB, only a line number.
   b. Line number missing before GOSUB.
   c. TO 80 not permitted after RETURN.
   d. Same line number before and after GOSUB not permitted.

8. a. Values of each entry in the A-array are doubled.
   b. The position of numbers in a list are moved up by one with the first and last interchanged.

9. a. 70 GOSUB 500
   b. 70 GOSUB 500

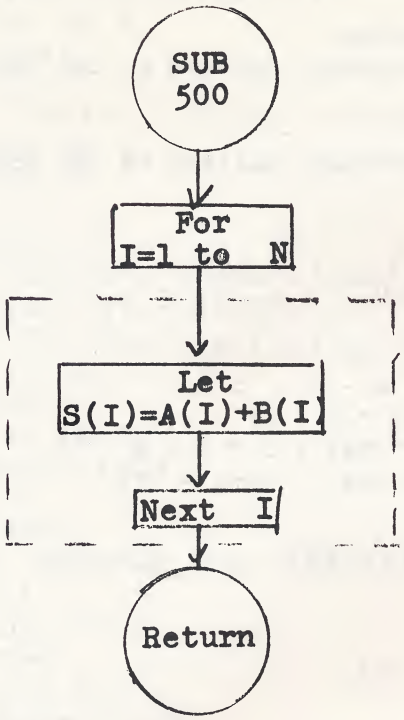
10. a. The first number in an array is subtracted from all the numbers in the array including the first.
    b. 150 GOSUB 700

11.

```
700 LET P=A(1)
710 FOR I=1 TO N
720 LET A(I)=A(I)-P
730 NEXT I
740 RETURN
```

12. 1000 FOR I=1 TO N and 1030 RETURN

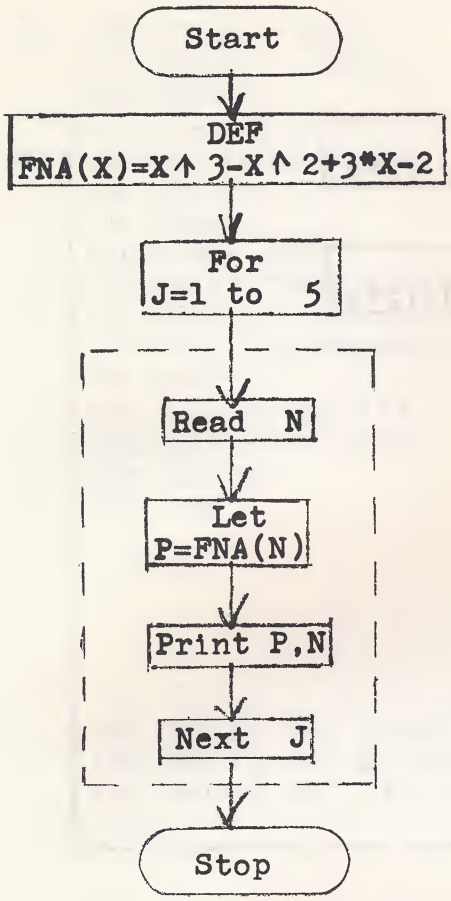
13.



14.
```
200 FOR I=1 TO N
210 PRINT
220 NEXT I
230 RETURN
```

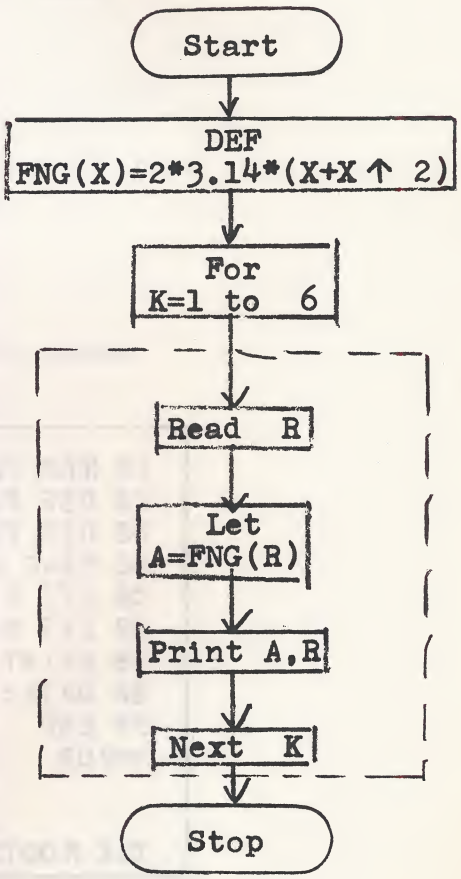
15. a.
```
20 LET N = 1
30 GOSUB 200
```
b.
```
20 LET N = 3
30 GOSUB 200
```
c.
```
20 LET N = 10
30 GOSUB 200
```

16.
```
10 REM PROBLEM 16
15 DEF FNA(X) = X↑3 - X↑2 + 3*X - 2
20 FOR J=1 TO 5
25 READ N
30 LET P=FNA(N)
35 PRINT 'VALUE OF P IS';P;' FOR N=';N
40 NEXT J
45 DATA 1,3,5,7,9
50 END

>>RUN

VALUE OF P IS 1  FOR N= 1
VALUE OF P IS 25  FOR N= 3
VALUE OF P IS 113  FOR N= 5
VALUE OF P IS 313  FOR N= 7
VALUE OF P IS 673  FOR N= 9
```



17.

```
10 REM PROBLEM 17
15 DEF FNG(X) = 2*3.14*(X+X↑2)
20 FOR K=1 TO 6
25 READ R
30 LET A=FNG(R)
35 PRINT 'VALUE OF A IS';A;' FOR R=';R
40 NEXT K
45 DATA 1,3,2.5,5,7.7,9.1
50 END


>>RUN


VALUE OF A IS 12.56  FOR R= 1
VALUE OF A IS 75.36  FOR R= 3
VALUE OF A IS 54.95  FOR R= 2.5
VALUE OF A IS 188.4  FOR R= 5
VALUE OF A IS 420.69719  FOR R= 7.7
VALUE OF A IS 577.1948  FOR R= 9.1
```



18.

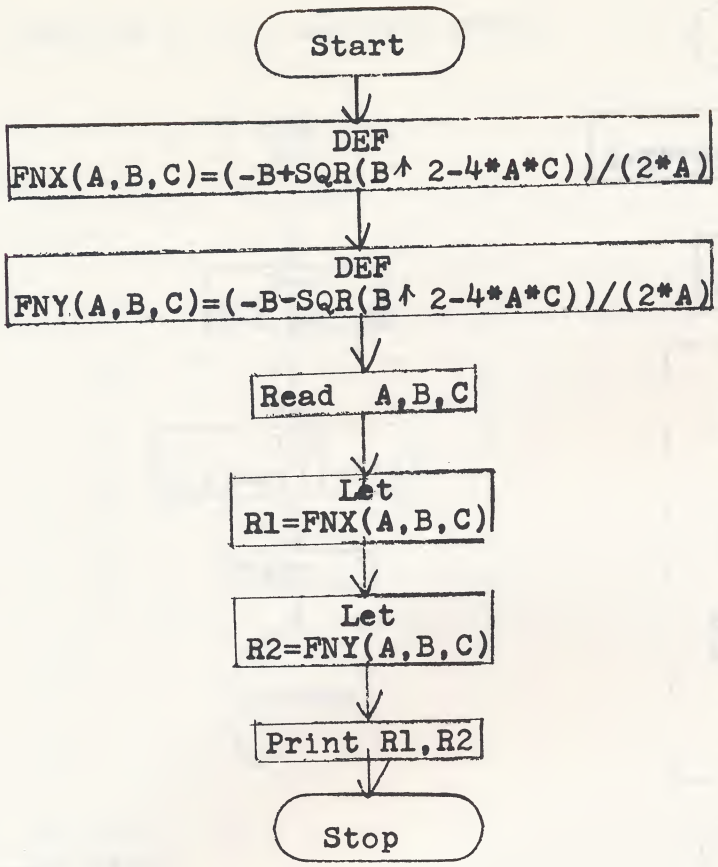


FIGURE 12.7

```
10 REM PROBLEM 18
20 DEF FNX(A,B,C) = (-B+SQR(B↑2-4*A*C))/(2*A)
30 DEF FNY(A,B,C) = (-B-SQR(B↑2-4*A*C))/(2*A)
40 READ A,B,C
50 LET R1=FNX(A,B,C)
60 LET R2=FNY(A,B,C)
70 PRINT 'THE ROOTS ARE';R1;' AND'; R2
80 DATA=7,-15,-32
90 END
>>RUN

THE ROOTS ARE 3.461921 AND -1.319063
```

19.
```
200 LET R1 = SQR(X)
210 LET R2 = - SQR(X)
220 RETURN
```

20.
```
10 REM PROBLEM 20
20 FOR J=1 TO 3
30 READ X
40 GOSUB 200
50 PRINT 'THE ROOTS ARE';R1;' AND ';R2
60 NEXT J
70 DATA 31.279,599.311,47665
80 STOP
200 LET R1=SQR(X)
210 LET R2=-SQR(X)
220 RETURN
230 END

>>RUN



THE ROOTS ARE 5.5927632  AND -5.5927632
THE ROOTS ARE 24.480829  AND -24.480829
THE ROOTS ARE 218.32315  AND -218.32315
```

ANSWERS TO PROBLEM SET 13

1. a. Too many MAT's in line 20.
   b. C has not been defined previously.
   c. Matrices must have the same number of rows and columns to be added.
   d. MAT instead of LET needed in line 20.
   e. Need MAT in line 30.
   f. Matrices A and S have not been DIMensioned.

2. a.
```
10 MAT READ A(2,3),B(2,3)
40 MAT C=A+B
```
   b.
```
30 MAT P=R*S
50 MAT PRINT P
```
   c.
```
20 MAT D=X-Y
```
   d.
```
10 MAT READ M(10,3),N(3,5)
30 MAT P=M*N
```

3. a.
```
10 MAT READ X(1,3)
```
   b.
```
10 MAT READ Y(3,1)
```
   c.
```
10 MAT READ Z(1,1)
```

4. a.

```
10 REM PROBLEM 4A, SET 13
20 MAT READ X(1,3),Y(3,1)
30 MAT Z=X*Y
40 MAT PRINT Z
50 DATA 1,0,2
60 DATA 1,2,-3
70 END
```

b.

```
10 REM PROBLEM 4B, SET 13
20 MAT READ A(3,3),B(3,3)
30 MAT C=A+B
40 MAT D=A-B
50 MAT PRINT C,D
60 DATA 1,-1,2,0,2,1,-1,0,5
70 DATA 2,0,1,1,-1,0,2,3,1
80 END
```

c.

```
10 REM PROBLEM 4C, SET 13
20 MAT READ R(2,3),S(3,3)
30 MAT T=R*S
40 MAT PRINT T
50 DATA 2,0,3,1,-1,2
60 DATA 3,0,1,0,1,1,2,0,-1
70 END
```

5.

```
10 REM PRØBLEM 5, SET 13
20 MAT READ P(4,1)
30 LET T=0
40 FØR J=1 TØ 4
50 LET T=T+P(J,1)
60 NEXT J
70 PRINT 'TØTAL PURCHASE=';T
80 DATA .85,.72,.34,.97
90 END

>>RUN

TØTAL PURCHASE= 2.88
```

7. a.
```
10 REM PRØBLEM 7    SET 13
20 MAT READ A(4,4),B(4,4),C(4,2)
30 DATA 3,2,-1,4,4,0,2,5,1,2,-1,6,5,2,0,0
31 DATA 1,2,1,0,0,3,1,-2,1,1,-1,-1,4,0,2,3
32 DATA 9,0,1,4,-1,2,5,2
40 MAT D=A+B
50 PRINT 'A+B='
60 MAT PRINT D;
70 MAT E=B+A
80 PRINT 'B+A='
90 MAT PRINT E;
100 END

>>RUN

A+B=

 4   4   0   4
 4   3   3   3
 2   3  -2   5
 9   2   2   3
B+A=

 4   4   0   4
 4   3   3   3
 2   3  -2   5
 9   2   2   3
```

b.
```
10 REM PRØBLEM 7    SET 13
20 MAT READ A(4,4),B(4,4),C(4,2)
30 DATA 3,2,-1,4,4,0,2,5,1,2,-1,6,5,2,0,0
31 DATA 1,2,1,0,0,3,1,-2,1,1,-1,-1,4,0,2,3
32 DATA 9,0,1,4,-1,2,5,2
40 MAT D=A*B
50 PRINT 'A*B='
60 MAT PRINT D;
70 MAT E=B*A
80 PRINT 'B*A='
90 MAT PRINT E;
100 END

>>RUN

A*B=

 18   11   14   9
 26   10   12   13
 24   7    16   15
 5    16   7   -4
B*A=

 12   4   2   20
 3   -2   5   21
 1   -2   2   3
 29   18  -6   28
```

c.
```
10 REM PROBLEM 7    SET 13
20 MAT READ A(4,4),B(4,4),C(4,2)
30 DATA 3,2,-1,4,4,0,2,5,1,2,-1,6,5,2,0,0
31 DATA 1,2,1,0,0,3,1,-2,1,1,-1,-1,4,0,2,3
32 DATA 9,0,1,4,-1,2,5,2
40 MAT F=B*C
41 MAT D=A*F
50 PRINT 'A*(B*C)'
60 MAT PRINT D;
70 MAT G=A*B
71 MAT E=G*C
80 PRINT '(A*B)*C'
90 MAT PRINT E;
100 END

>>RUN

A*(B*C)

 204  90
 297  90
 282  90
 34  70
(A*B)*C

 204  90
 297  90
 282  90
 34  70
```

d.
```
10 REM PROBLEM 7    SET 13
20 MAT READ A(4,4),B(4,4),C(4,2)
30 DATA 3,2,-1,4,4,0,2,5,1,2,-1,6,5,2,0,0
31 DATA 1,2,1,0,0,3,1,-2,1,1,-1,-1,4,0,2,3
32 DATA 9,0,1,4,-1,2,5,2
40 MAT F=A+B
41 MAT D=F*C
50 PRINT '(A+B)*C='
60 MAT PRINT D;
70 MAT G=A*C
71 MAT H=B*C
72 MAT E=G+H
80 PRINT '(A*C)+(B*C)='
90 MAT PRINT E;
100 END

>>RUN

(A+B)*C=          (A*C)+(B*C)=

 60  24            60  24
 51  24            51  24
 48  18            48  18
 96  18            96  18
```

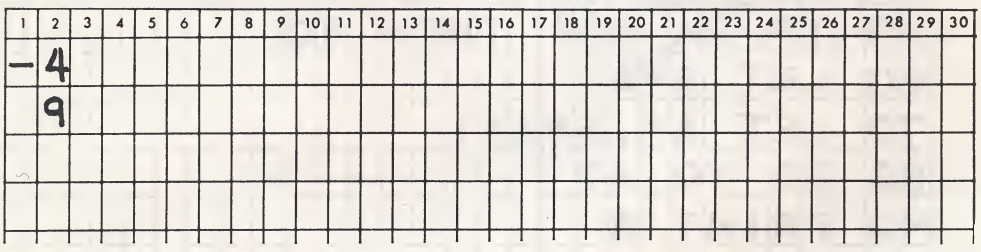
```
e. 10 REM PRØBLEM 7    SET 13
   20 MAT READ A(4,4),B(4,4),C(4,2)
   30 DATA 3,2,-1,4,4,0,2,5,1,2,-1,6,5,2,0,0
   31 DATA 1,2,1,0,0,3,1,-2,1,1,-1,-1,4,0,2,3
   32 DATA 9,0,1,4,-1,2,5,2
   40 MAT F=A+B
   41 MAT D=F*C
   50 PRINT '(A+B)*C='
   60 MAT PRINT D;
   70 MAT G=A*C
   71 MAT E=G+B
   80 PRINT 'A*C+B='
   90 MAT PRINT E;
   100 END

   >>RUN

   (A+B)*C=

    60   24
    51   24
    48   18
    96   18
    CØNFLICTING MATRIX DIMENSIØN FØR ØPERATIØN IN 71.

    RUN STØPPED.
```

8.
```
a. 10 REM PRØBLEM  8,  SET 13
   20 MAT READ T(3,3),V(3,3)
   30 DATA 1,2,3,4,5,6,9,0,7
   31 DATA 0,1,2,-2,1,1,1,0,-1
   40 MAT S=T+V
   50 PRINT 'THE ELEMENTS ØF THE FIRST RØW ØF THE SUM MATRIX ARE'
   60 FØR I=1 TØ 3
   70 PRINT S(1,I);
   80 NEXT I
   90 END

   >>RUN

   THE ELEMENTS OF THE FIRST RØW ØF THE SUM MATRIX ARE
    1   3   5
```

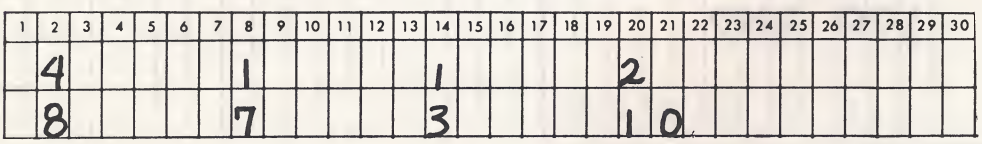
```
b.10 REM PRØBLEM 8, SET 13
  20 MAT READ T(3,3),V(3,3)
  30 DATA 1,2,3,4,5,6,9,0,7
  31 DATA 0,1,2,-2,1,1,1,0,-1
  40 MAT P=T*V
  50 PRINT 'THE ELEMENTS ØF THE SECØND CØLUMN ØF THE PRØDUCT ARE'
  60 FØR I=1 TØ 3
  70 PRINT P(I,2);
  80 NEXT I
  90 END

  >>RUN

  THE ELEMENTS ØF THE SECØND CØLUMN ØF THE PRØDUCT ARE
   3  9  9
```

```
c.10 REM PRØBLEM 8, SET 13
  20 MAT READ T(3,3),V(3,3)
  30 DATA 1,2,3,4,5,6,9,0,7
  31 DATA 0,1,2,-2,1,1,1,0,-1
  40 MAT D=T-V
  45 PRINT 'THE DIFFERENCE MATRIX'
  50 MAT PRINT D;
  55 PRINT 'THE DIAGØNAL ELEMENTS ARE'
  60 FØR I=1 TØ 3
  70 PRINT D(I,I);
  80 NEXT I
  90 END

  >>RUN

  THE DIFFERENCE MATRIX

   1  1  1
   6  4  5
   8  0  8
  THE DIAGØNAL ELEMENTS ARE
   1  4  8
```

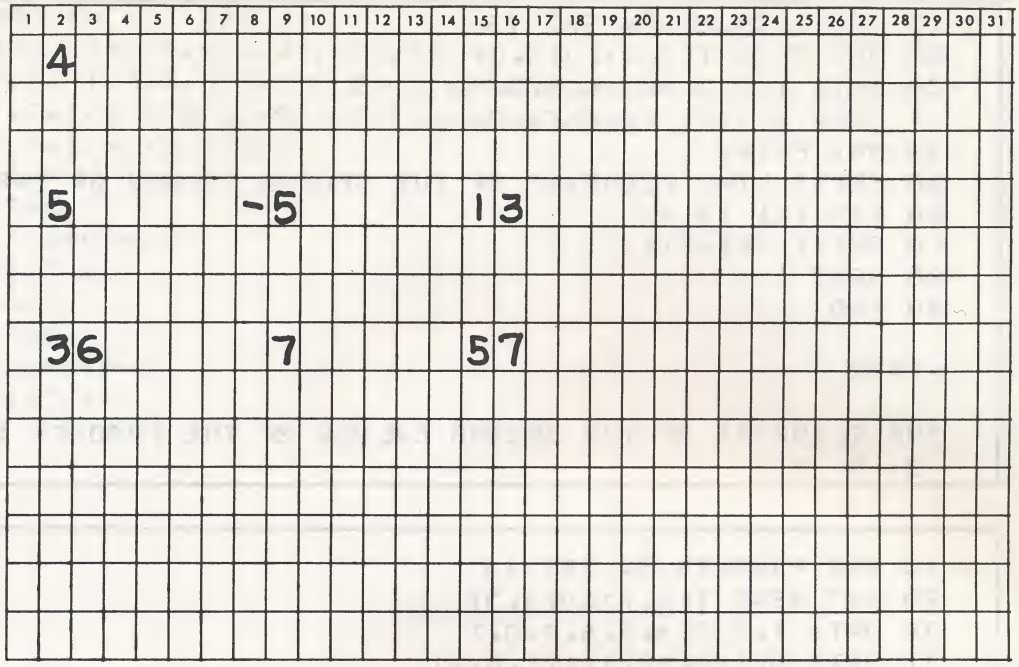
9. a.



b.



c.



ANSWERS TO PROBLEM SET 14

1. Converging Loop Component
   a. Test step
   b. Formula step
   c. Initialization step
   d. Exit step

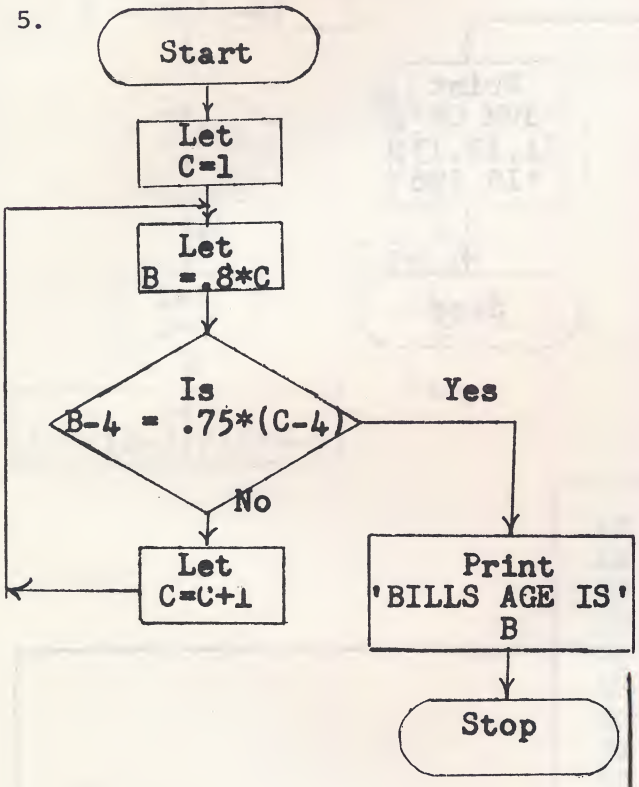
2.

```
10 REM PROBLEM 2
20 LET A=4
30 LET S=0
40 LET D=ABS(S-A)
50 IF D<.001 THEN 90
60 LET S=A
70 LET A=.5*A+1
80 GO TO 40
90 PRINT A
100 END
```

3. The first three computed guesses are:
   A = 3
   A = 2.5
   A = 2.25

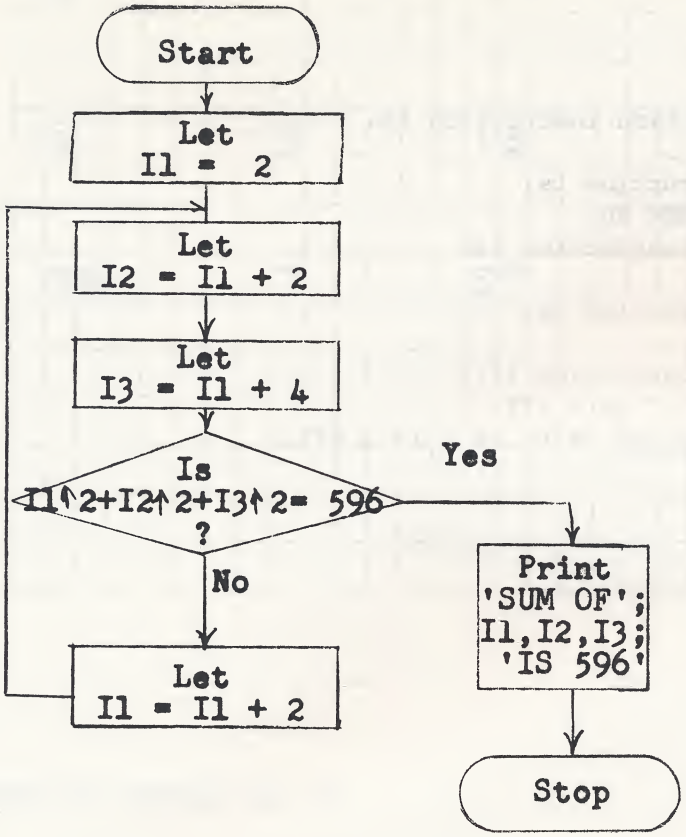
4. a. The initialization instruction is:
   10 LET X=2
   b. The test instruction is:
   40 IF D<.05 THEN 80
   c. The re-entry instruction is:
   70 GO TO 30
   d. The exit instruction is:
   80 PRINT X
   e. The formula instruction is:
   60 LET X = .75 * (X + 1/X)
   f. The first computed value of X is 1.875.

5.



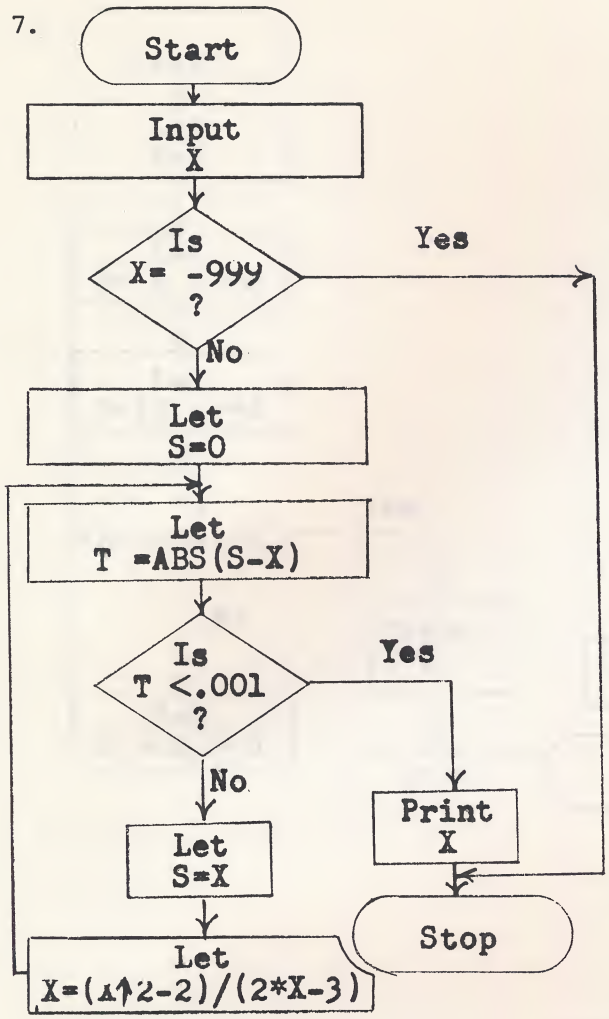

```
10 REM PROBLEM 5
20 LET C=1
30 LET B=.8*C
40 IF B-4 = .75*(C-4) THEN 70
50 LET C = C+1
60 GOTO 30
70 PRINT "BILLS'S AGE IS ";B
80 END

>>RUN


BILL'S AGE IS  16
```

6.



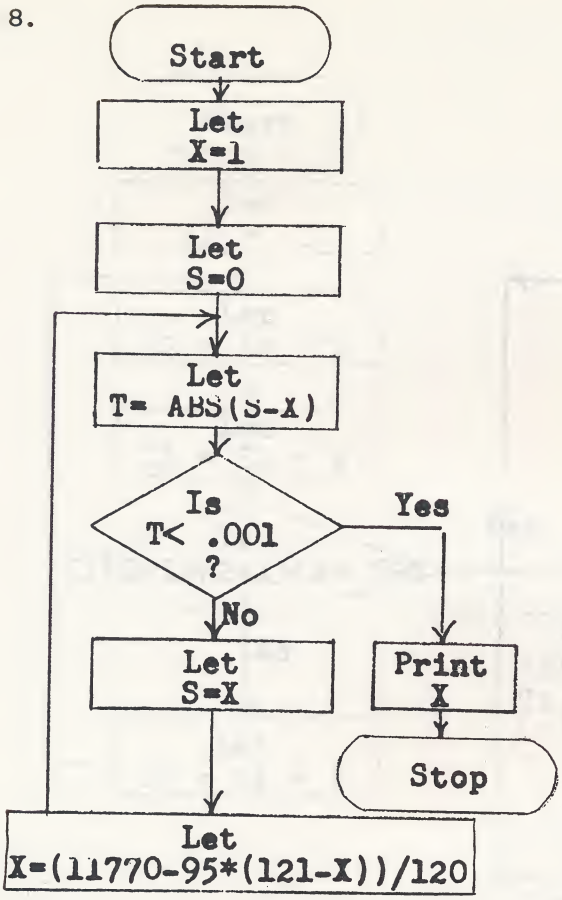

```
10 REM PROBLEM 6
20 LET I1=2
30 LET I2=I1+2
40 LET I3=I1+4
50 IF I1↑2+I2↑2+I3↑2=596 THEN 80
60 LET I1=I1+2
70 GO TO 30
80 PRINT 'SUM OF SQUARES OF';I1;I2;I3;
90 PRINT 'IS 596'
100 END

>>RUN


SUM OF SQUARES OF 12  14  16  IS 596
```

7.



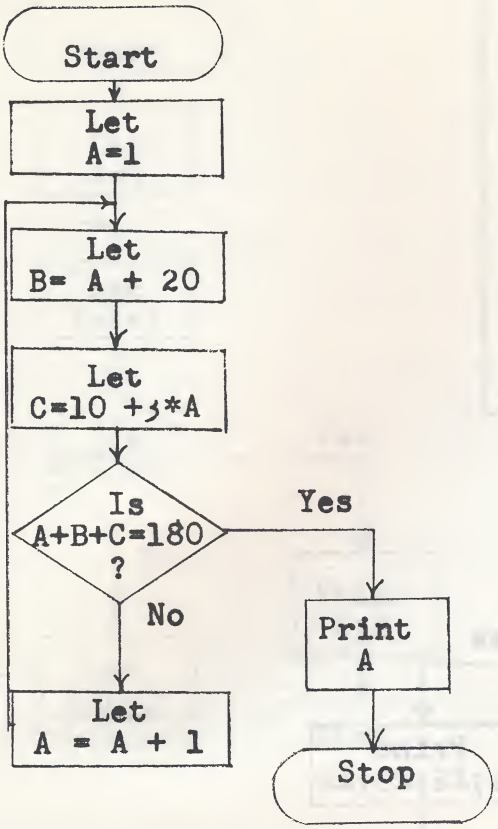

```
10 REM PROBLEM 7
20 INPUT X
25 IF X=-999 THEN 100
30 LET S=0
40 LET T=ABS(S-X)
50 IF T<.001 THEN 90
60 LET S=X
70 LET X=(X↑2-2)/(2*X-3)
80 GO TO 40
90 PRINT 'A ROOT OF X↑2-3*X+2=0 IS ';X
100 END

>>RUN

? >-1
A ROOT OF X↑2-3*X+2=0 IS  1

>>RUN

? >5
A ROOT OF X↑2-3*X+2=0 IS  2
```

8.



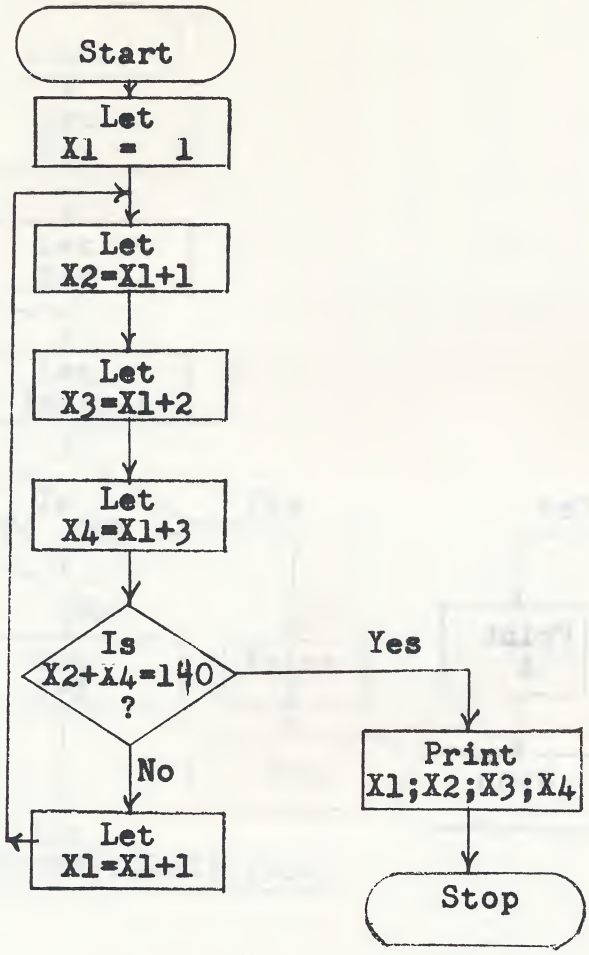

```
10 REM PROBLEM 8
20 LET X=1
30 LET S=0
40 LET T = ABS(S-X)
50 IF T<.001 THEN 90
60 LET S = X
70 LET X = (11770 - 95*(121-X))/120
80 GOTO 40
90 PRINT "A. KELLY SELLS "; X; "QUARTZ CRYSTAL WATCHES."
100 END

>>RUN

A. KELLY SELLS  10.9965 QUARTZ CRYSTAL WATCHES.
```

9.



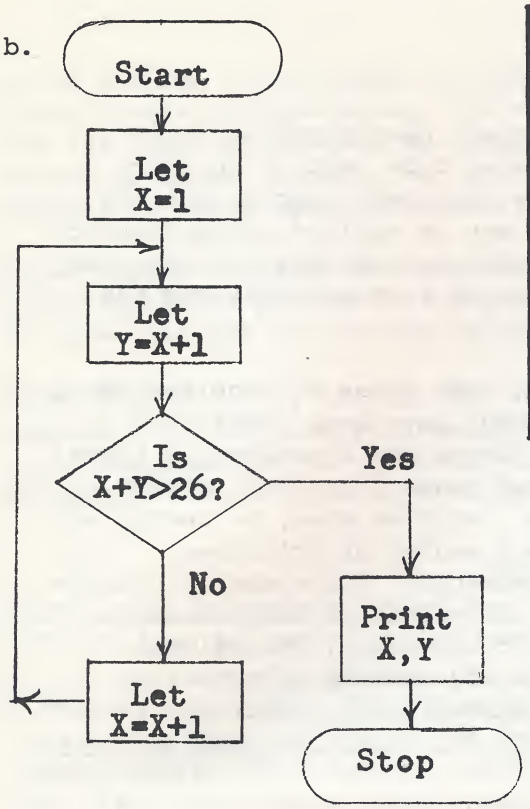

```
10 REM PROBLEM 9
20 LET A=1
30 LET B=A+20
40 LET C=10+3*A
50 IF A+B+C=180 THEN 80
60 LET A=A+1
70 GO TO 30
80 PRINT 'ANGLE A=';A
90 END


>>RUN


ANGLE A= 30
```

10. a.



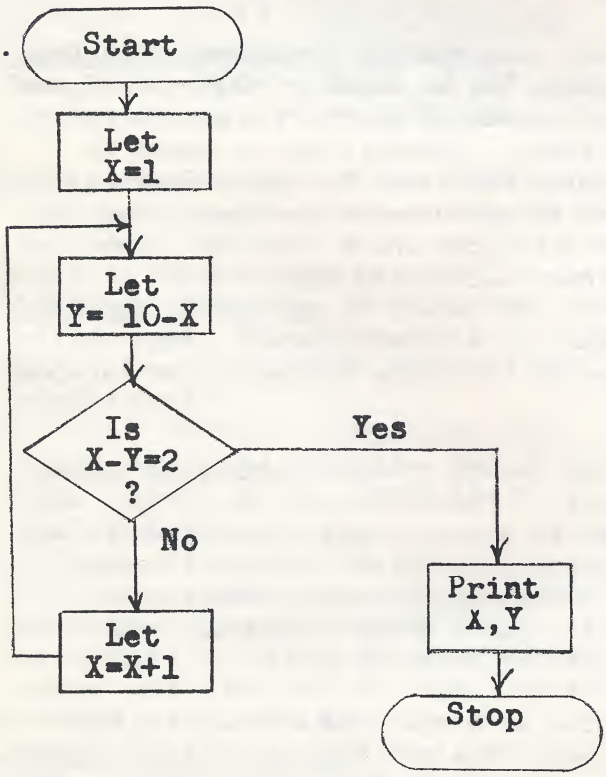

```
10 REM PROBLEM 10
20 LET X1=1
30 LET X2=X1+1
40 LET X3=X1+2
50 LET X4=X1+3
60 IF X2+X4=140 THEN 90
70 LET X1=X1+1
80 GO TO 30
90 PRINT "INTEGERS ARE";X1;X2;X3;X4
100 END
P

RUN


INTEGERS ARE 68   69   70   71
```

b.




```
10 REM PROBLEM 10
20 LET X=1
30 LET Y=X+1
40 IF X+Y>26 THEN 70
50 LET X=X+1
60 GO TO 30
70 PRINT 'INTEGERS ARE';X;Y
80 END

>>RUN

INTEGERS ARE 13   14
```

c.




```
10 REM PROBLEM 10
20 LET X=1
30 LET Y=10-X
40 IF X-Y=2 THEN 70
50 LET X=X+1
60 GO TO 30
70 PRINT 'INTEGERS ARE':X:Y
80 END

>>RUN


INTEGERS ARE 6  4
```

APPENDIX Computer Use in Mathematics Classes

The Problem Sets at the end of each Topic contain many problems which relate computer science to mathematics. Because this text is an introduction to programming, the math involved has been kept simple, but the programming techniques included in this text may be applied to mathematics at any level of sophistication. The other math applications you may wish to use in your class depend only on the skills of your students and the subject matter of your class.

We have described in the following paragraphs some types of problems which may be assigned after certain topics in the book have been completed. Algebra classes may use problems concerning slopes and equations of lines, solutions of equations of various degrees, and general problem solving. Geometry classes may concentrate on problems involving area, perimeter and volume formulas, angles of polygons, sides and angles of triangles, geometric means, and equations of analytic geometry. Trigonometry classes may concentrate on series approximations to the values of trigonometric functions, solving triangles and trigonometric equations. Vocational classes may concentrate on formulas which specify amounts of materials needed for certain types of jobs, and other formulas of similar practical bent.

After Topics 1 and 2 have been completed, students may be assigned programming problems involving simple equations and formulas such as time-rate-distance formula and Ohm's Law. The quadratic formula, equations of motion for falling bodies, and the Pythagorean and Hero Theorems may be programmed. After Topic 3 has been completed, students may be asked to read in data and label input and output in the printouts.

After Topics 4 and 5 have been completed, students may be assigned problems involving decisions. For example, students may be asked to write a program which determines the number of roots and nature of roots of a quadratic equation, and then calculates the real roots. Students may be asked to write a program which repeats the averaging algorithm for approximating square roots a specified number of times to approximate the square root of a given number. Related to this may be a program which finds the number of times a certain series of calculations must be carried out in order to reach a given result. For example, given the amount of an initial deposit, a rate of compound interest, and an amount of accrued interest, find the amount of time it will take for the deposit to accrue the amount of interest entered.

After Topic 6 has been completed, you may assign problems involving a wide variety of applications which require all of the techniques of looping and accumulating covered thus far. Programs to generate and sum arithmetic and geometric series can be assigned. Programs to generate tables of calculated data - powers and roots, decimal equivalents, metric conversions, etc. - can be assigned. Trigonometric functions using series approximations, mean and standard deviations of given sets of data can now be assigned.

Topic 7 will permit the student to program an almost endless variety of trigonometric and logarithmic calculations. The RND function allows programs

to be written for problems in Probability and Statistics, especially those involving simulating, the Monte Carlo method, and game theory. The INT function permits the programming of a great number of Number Theory problems: finding factors of integers, generating prime numbers, finding greatest common divisors and least common multiples, etc.

After Topics 8 and 9, the student can be assigned problems involving polynomials and polynomial equations of any degree. In addition, systems of equations can be entered, stored, and manipulated after these topics.

After Topics 9, 10, 11, 12, 13, and 14, the student should have been exposed to sufficient programming language and techniques so that he or she could approach any problem likely to be encountered in the typical mathematics classes of high school or the first several years of college.

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Maryland Association of Educational Users of Computers, c/o Dianne Martin, Dept. of Computer Science, Univ. of Maryland, College Park, MD 20742

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TRS-80 Computer Information Exchange, Box 158, San Luis Rey, CA 92068

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